Environmental Measurements in the Beaufort Sea, Spring 1993

by T. Wen and F. Karig

Technical Memorandum
APL-UW TM 4-93
December 1993

This Technical Memorandum has received limited review.

Applied Physics Laboratory University of Washington
1013 NE 40th Street Seattle, Washington 98105-6698

SPAWARSYSCOM Contract N00039-91-C-0072

Approved for public release

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Acknowledgments

The research presented in this report was sponsored by the organizations participating in the ICEX 1-93 Applied Physics Laboratory Ice Station (APLIS). Funding was provided by the Naval Sea Systems Command, Code 06UR43. Participating laboratories were the Naval Undersea Warfare Center, New London Laboratory; the Naval Undersea Warfare Center, Arctic Submarine Laboratory; and the Naval Surface Warfare Center, Carderock Division.

The purpose of this report is simply to present the environmental data obtained during the camp. The data analysis is very limited. All the data presented here are stored in digital format and are available for further analysis. Requests for data should be forwarded to

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TABLE OF CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This report presents environmental data obtained by the Applied Physics Laboratory of the University of Washington (APL-UW) at APLIS 93, an ice camp established in the Beaufort Sea in Spring 1993 to support Navy-sponsored tests and research during ICEX 1-93. Data analysis is limited because the purpose of this report is to provide field data to ice camp participants. The data were collected to document the meteorological and oceanographic conditions that existed during camp activities. The main data sets are weather, floe drift, STD profiles, currents, and ice properties.

I. INTRODUCTION

This report presents environmental data taken in the spring of 1993 at APLIS (Applied Physics Laboratory Ice Station) in the Beaufort Sea. The ice camp was established and maintained by personnel from the Applied Physics Laboratory, University of Washington, to support Navy-sponsored research and test activities conducted by the organizations participating in ICEX 1-93. The environmental data — weather, floe drift, STD profiles, currents, and ice properties — were gathered by APL-UW personnel and are intended to support the analysis of experimental data obtained by ICEX 1-93 participants. APL-UW has been conducting acoustic and oceanographic research in the Arctic since the 1970s. The ICEX 1-93 data are therefore part of a growing database for the Beaufort Sea.

APLIS 93 was established on a multiyear floe approximately 275 km north of Prudhoe Bay, Alaska (see Figure 1). The floe was selected on 22 March after a one-day search. Camp setup took place the following week. During this build-up phase, five people erected a mess hall, sleeping quarters, generators, and control building. Collection of environmental data started on 29 March and lasted until 16 April, when the objectives of ICEX 1-93 were met. During the test period, personnel at the camp numbered as many as 35 and dwindled to only a few near the end. Evacuation of the camp was completed on 17 April.

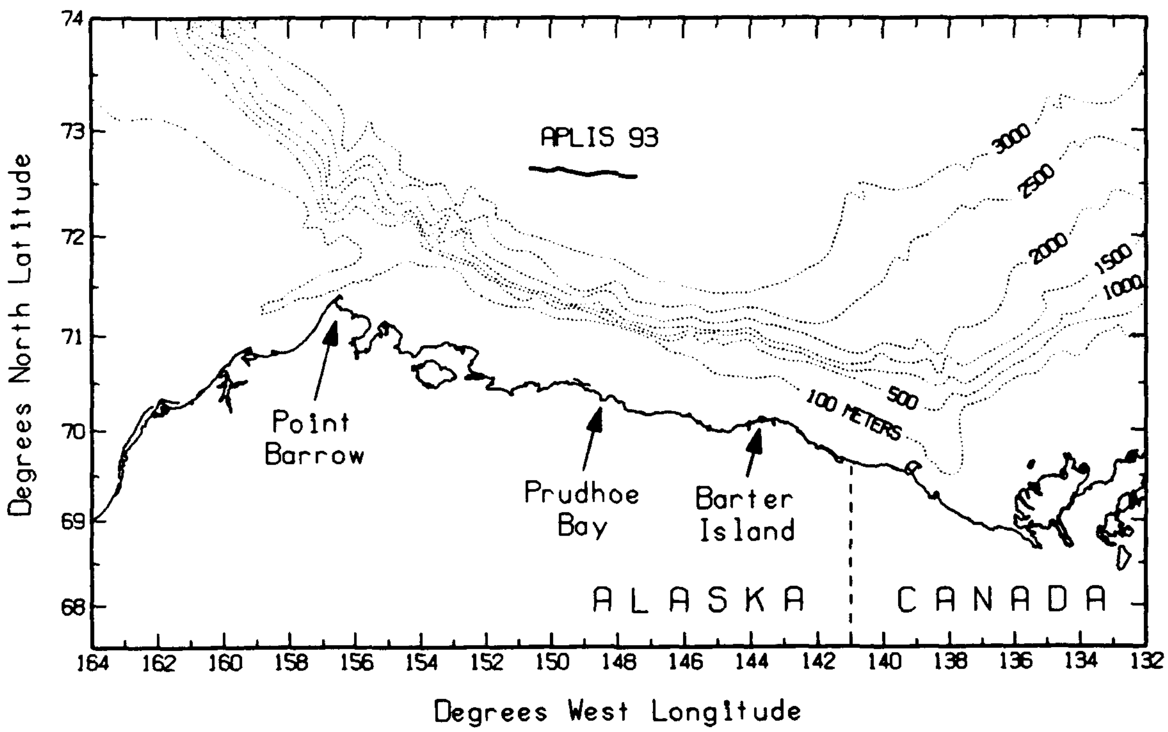

Figure 1. Position of APLIS 93.

For quick access to a runway, a site at the edge of the floe next to a flat refrozen lead was chosen for the camp. The thickness of the ice at the camp and at other level locations of the floe was 2–3 m. The runway lead was about 1 m thick and over 500 m long. An underwater acoustic tracking range consisting of four hydrophones was deployed to track underwater vehicles participating in the ICEX tests.

Air temperature and pressure and wind speed and direction were recorded automatically at 5-minute intervals. The weather was generally calm, except for a 24-hour period during which high winds built up snow drifts in and around the camp.

Because the floe drifted in response to wind stress, its position needed to be tracked for the analysis of some data such as satellite imagery. Latitude and longitude of the floe supplied by a GPS receiver were logged at 30-minute intervals and also used to determine drift speed and direction.

CTD casts were made often to determine the properties of the water column down to 350 m. Sound speed profiles were then derived from the measured temperature and salinity and were used to predict the real-time performance of acoustic equipment and the underwater tracking range.

The time of acquisition for some data is tagged "L" for local time, while others are tagged "UTC" for Universal Coordinated Time. Local time is UTC – 9 hours.

Because the purpose of this report is simply to present environmental data from the camp, analysis is very limited. All data presented here are stored in digital format and are available upon request. The Spring 1993 CTD data, as well as those from previous years, are also available from the National Oceanographic Data Center in Washington, D.C.

II. THE FLOE

Selection of an ice floe suitable for a camp was based on several requirements. First, we needed a refrozen lead long enough and thick enough (at least 1 m) to serve as a runway, since transportation to and from the camp depended entirely on aircraft (only one Twin Otter this year). Second, the floe had to be over deep water for the long-range underwater tracking operation. This required that the camp be located north of 72° latitude, where the water is at least 3000 m deep. Third, the initial site had to be far enough east to allow for the westerly drift that would (historically) occur during the period of camp occupancy. As in previous years, the first criterion narrowed down the usable floes to those north of 72°N so the second criterion was fulfilled automatically. This year, a suitable floe was found at 72.5°N and 147.1°W after one day of air search.

The camp was established at the edge of the floe, next to a refrozen lead (see Figure 2). Ice in the floe, excluding hummocks, varied from 2 to 3 m thick, with a snow cover of 5–10 cm. Ice in the refrozen lead was 1 m thick with the same amount of snow cover. A 550-m runway was constructed on the lead by leveling off the uneven snow cover with a snowmobile-towed grader. Figure 3 shows an ERS-1 C-band microwave SAR image of the ice pack. The X marks the location of the camp. In this image, made on 15 April, light areas represent multiyear ice and dark areas represent first-year or young ice. The darkest area, such as the one found in the upper right-hand corner, was most likely open water.

Figure 2. Aerial photo of ice camp.

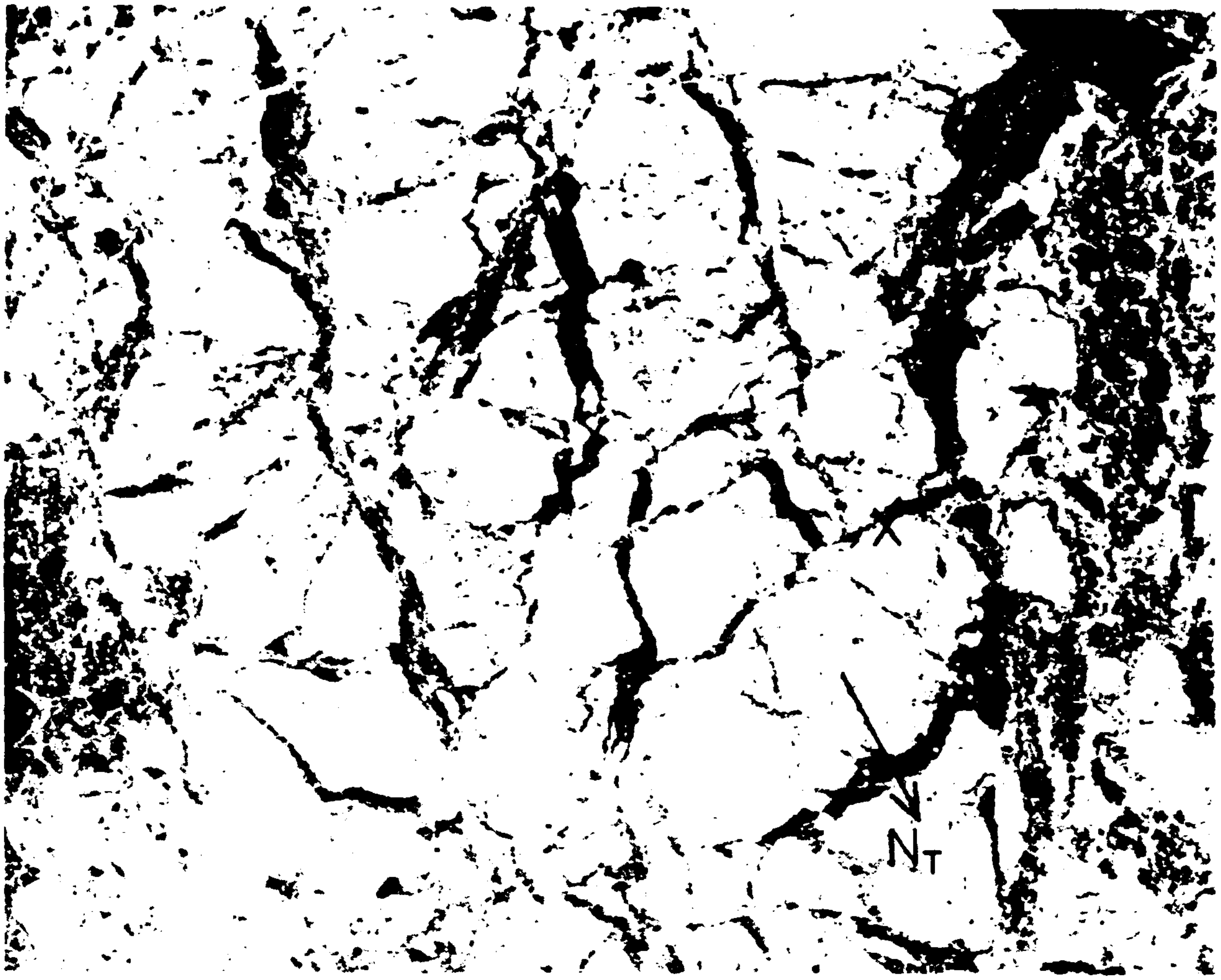

Figure 3. C-band microwave SAR image of 25 km × 25 km area containing the ice floe. ERS-1, Beaufort Sea, 15 April 1993. Dark areas represent mostly first-year ice and some open water. (Copyright European Space Agency; provided by Alaska SAR facility)

The ICEX 1-93 tests involved submarines. To track the submarines, we set up an underwater tracking range with an imaginary X-Y coordinate system shown in Figure 4. The origin of the coordinate system was a 1-m-diameter hydrohole (marked "O" on the figure) beneath the control building. Four hydrophones, each approximately 500 m from the camp, were suspended at 30.5-m depth for receiving cw pulses transmitted by the submarines. The signals were cabled back to the control building, filtered, amplified, validated, and time stamped. An x,y fix can then be made based on the time-of-flights and an average sound speed. The operational distance of the range is 15,000 m, sometimes as far as 20,000 m, but with large scatter in the x,y fixes. To transform an x,y fix in

the arbitrary X-Y system to earth coordinates, the latitude and the longitude of the origin and the true bearing of the +Y axis must be known. The true bearing of the +Y axis was determined by celestial sightings and was found to vary from 84.8° to 82.3° due to floe rotation.

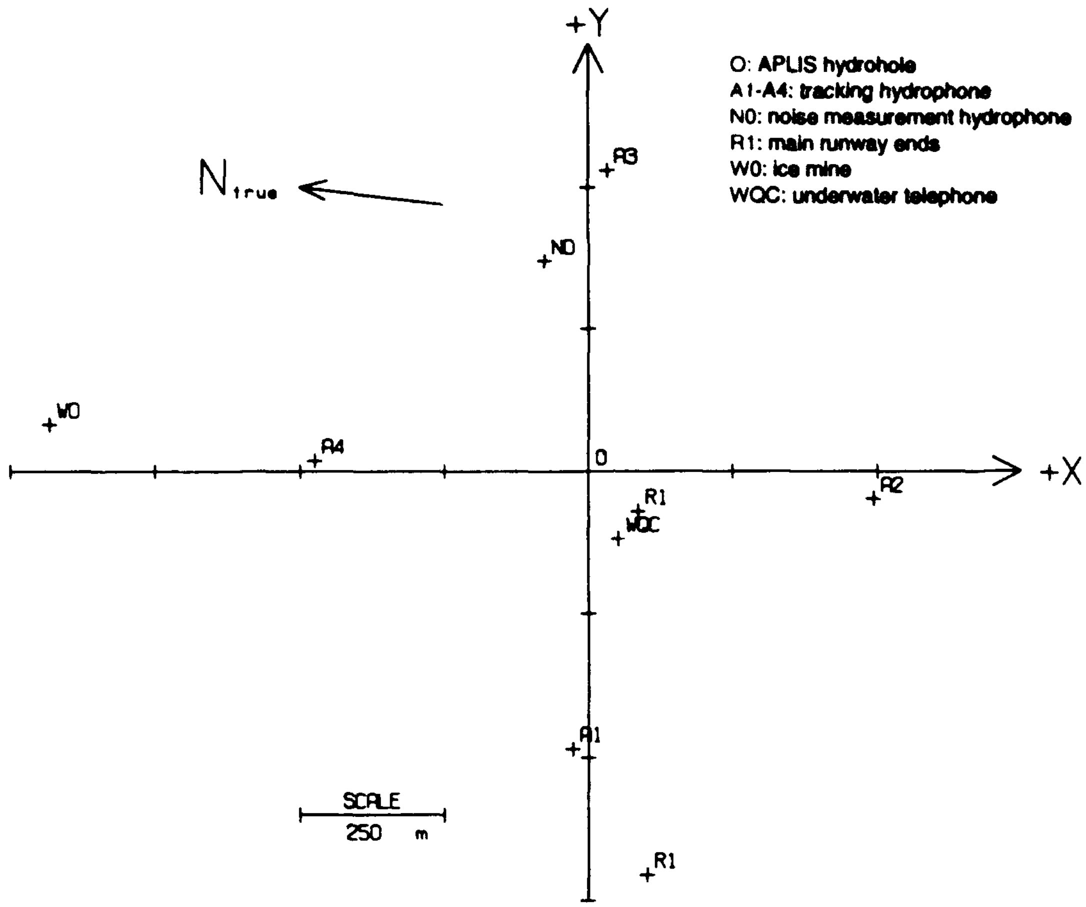

Figure 4. Underwater tracking range X-Y coordinate system.

The magnetic variation at the general locale was 31°, calculated using GEOMAG, a PC program published by the Naval Oceanographic Office and based on the World Magnetic Model for Epoch 1990 (WMM-90).

III. FLOE MOVEMENT

The camp's position was determined using a Global Positioning System (GPS) receiver (Kinemetrics/Truetime GPS-DC) and displayed and logged on a PC computer via RS-232 bus. GPS fixes were read from the receiver every 30 minutes and stored on a floppy disk. At least four GPS satellites were in view 99% of the time. Consequently, the geometric dilution of precision, an indicator of tracking precision, was usually 3 or less. But because of the uncertainty of up to 100 m in the fixes, the data had to be smoothed using an 11-point binomial filter during postprocessing. The smoothing operation is essential when floe drift speed and direction are to be determined. Figure 5 shows the drift track of the floe. During the camp period, the floe drifted a net distance of 118 km toward the west. Drift speed and direction are plotted in Figure 6 along with wind speed and direction (sense reversed); the plots show good correlation between the wind and drift. As a rule of thumb, the floe drift speed is about 1/60–1/50 of the wind speed, sometimes even less, and its direction is about 45° to the right of the wind direction[1–3] due to the Coriolis force. The floe's position, as well as its drift speed and direction, is listed in Appendix A.

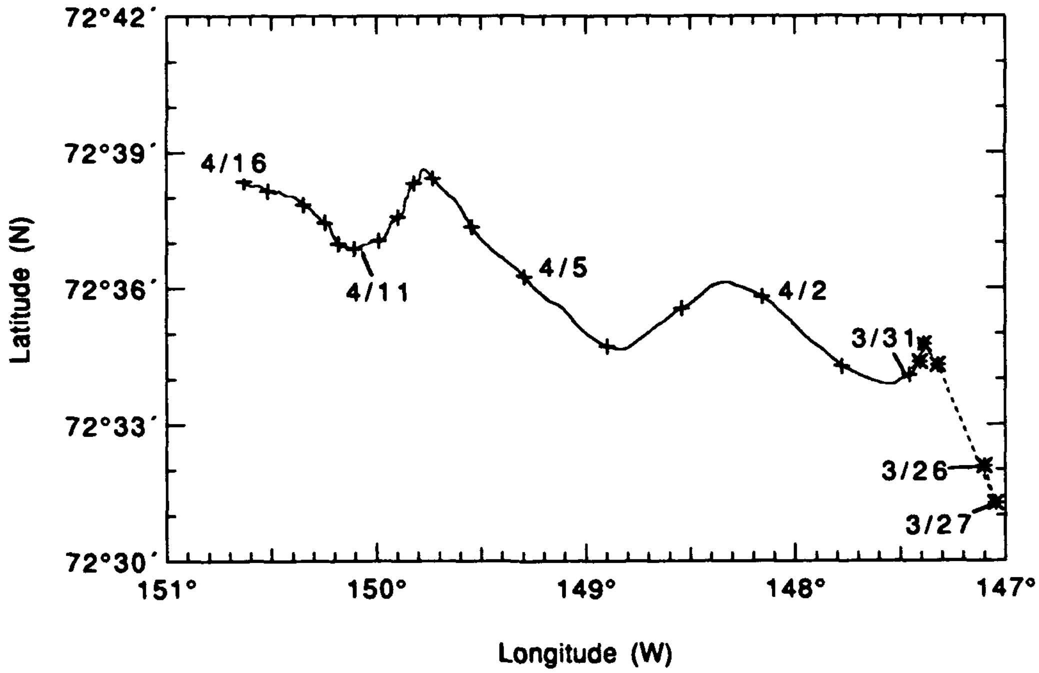

Figure 5. Drift track of APLIS 93. Asterisks denote positions obtained with a portable GPS receiver.

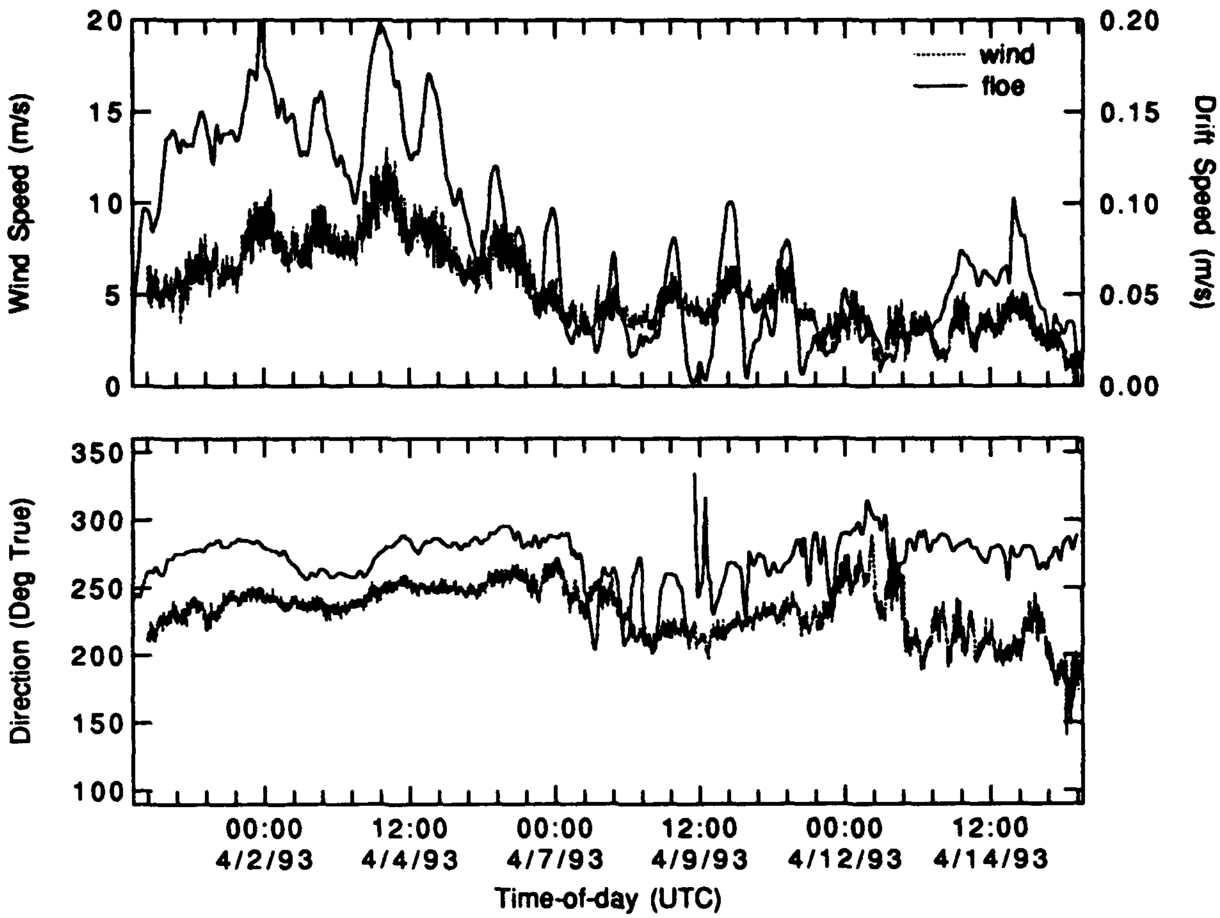

Figure 6. Floe drift speed and direction, with wind data superposed for comparison.

Our GPS receiver also provided 1-Hz timing pulses accurate to within microseconds of UTC. These were used to check the drift of the tracking range master clock and were therefore crucial to the precision of our underwater tracking range.

The rotation of the floe was determined by measuring the change in the true bearing of the +Y axis of the X-Y coordinate system. To obtain the true bearing of the +Y axis, the grid bearing of the Sun was first read with a transit set up on top of the control building over the hydrohole at (0,0). The time at which the bearing was read was noted to the nearest second. Using the time and current location, the true bearing of the Sun was calculated using the PC program MICA (Multiyear Interactive Computer Almanac; U. S. Naval Observatory, Washington, D.C.). The difference between the grid and true bearings of the Sun was the true bearing of the +Y axis. Celestial sightings were made frequently until the last few days when overcast conditions precluded sightings. The +Y axis of the coordinate system varied from 84.8° to 82.3° during the observation period (see Table 1), indicating a CCW floe rotation of 2.5°.

*Table 1. Bearing of the +Y axis of underwater tracking range. All sightings were made on the Sun with the exception of one on Venus, flagged with *.*

Time (UTC) mmdd	hhmmss	Lat. dd mm ss	Long. ddd mm ss	Azimuth of Sun	Grid Bearing	True Bearing of +Y Axis
0401	002926	72 34 19	147 47 07	220.71	135.87	84.84
	005330	72 34 21	147 47 34	226.93	142.02	84.91
0403	194645	72 34 39	148 48 48	144.85	60.73	84.12
	195017			145.77	61.67	84.10
0404	231933	72 36 13	149 17 12	201.45	116.62	84.83
	232205			202.12	117.31	84.81
0406	000120	72 37 21	149 32 42	212.39	127.52	84.87
	000707			213.91	129.02	84.89
0407	021226	72 38 32	149 45 02	245.74	160.92	84.82
	021448			246.32	161.52	84.80
0408	175538	72 37 45	149 52 02	115.46	30.83	84.63
	175915			116.36	31.71	84.65
0409	201601	72 37 11	149 57 25	151.44	67.79	83.65
	201925			152.34	68.70	83.64
	235259	72 37 04	149 59 22	210.26	126.84	83.42
	235643			211.25	127.83	83.42
0410	074946	72 36 57	150 02 27	156.86	73.64	83.22*
	173715	72 36 58	150 04 15	110.65	27.75	82.90
	174016			111.39	28.53	82.86
	214558	72 36 54	150 05 26	175.75	93.07	82.68
	214910			176.63	93.97	82.66
0411	235358	72 36 59	150 10 59	210.58	128.22	82.36
	235711			211.44	129.08	82.36

IV. WEATHER

Weather information was important for research as well as for logistics. There was also general interest in the wind speed and air temperature. Weather parameters therefore became one of the routine environmental measurements made at APLIS 93. Data were collected by a weather station (Weatherpak 100/Coastal Climate Co.) mounted on a telescoping mast at a height of 10 m. The mast was guy-wired so that it would not sway in high winds and cause erroneous wind speed readings. Air temperature, atmospheric pressure, and wind speed and direction were measured and recorded at regular intervals. The accuracy of the meteorological measurements is 0.5 m/s for wind speed, 2° for wind direction, 0.5 mbar for atmospheric pressure, and 0.2°C for temperature.

A laptop PC in the control building was used to control the weather station and to display meteorological data. Commands and data were sent over an RS-232C link. The Weatherpak was programmed to average the weather parameters for 5 s at 5-minute intervals. Sampled data were stored in the Weatherpak's internal memory and also downloaded to the PC for display and storage on floppy disk. Weather parameters could also be read at any time by pressing a programmed menu key on the PC.

The data are plotted and presented in Figure 7. Wind direction was originally logged as magnetic but has been converted to true using an average variation of 31°. The temperature and the wind speed showed diurnal variations until the overcast condition set in. With the overcast, the temperature hovered about −10° C. During this period of high temperatures and low winds, the weather seemed very warm, compared to earlier times.

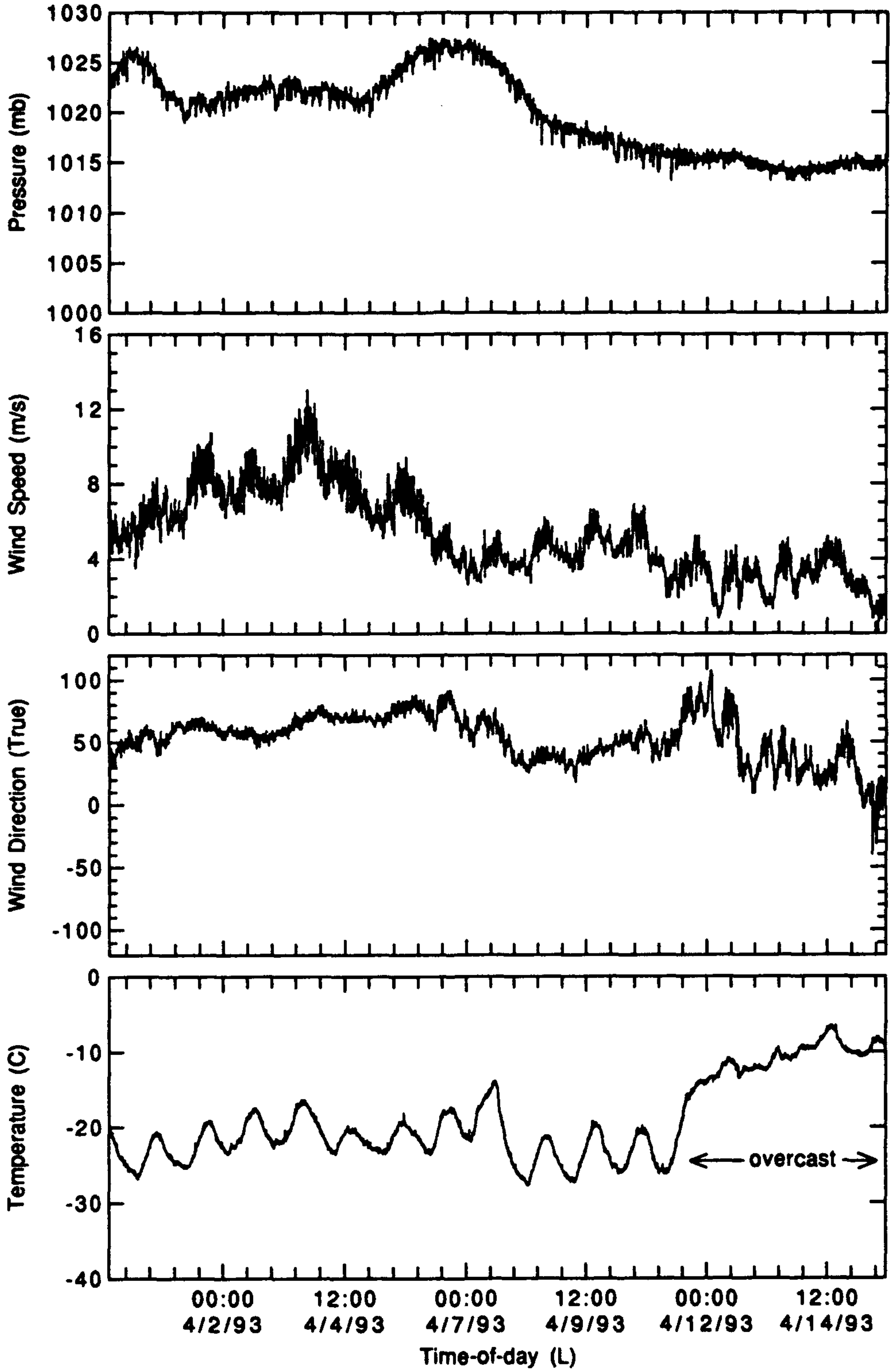

Figure 7. Weather parameters.

V. CTD MEASUREMENTS

CTD casts were made daily to obtain the temperature and salinity properties of the water column. The components of the CTD profiler were a solid-state data logger (Sea-Bird), a thermistor (Sea-Bird), a conductivity cell (Sea-Bird), and a pressure sensor (Paroscientific Digiquartz). The profiler was attached to the end of a 6.4-mm-diameter nylon line and deployed with an ac-powered winch. To ensure adequate flushing of seawater through the conductivity cell, the profiler was allowed to free-fall (attached to the line), reaching a speed of ~1.3 m/s. With the sampling rate of the logger at 8 Hz, the water column was consequently sampled at ~16 cm intervals, resulting in high-resolution temperature and salinity profiles. The casts were generally to only ~350 m or less because water properties at greater depths do not vary significantly from day to day. After each cast, the raw data were read out of the logger via an RS-232C link to a laptop PC for processing and plotting. The raw data were first converted to temperature, conductivity, and depth using sensor calibration constants. UNESCO '83 algorithms[4] were then used to compute salinity, sound speed, and σ_t (the density of the *in situ* water with the pressure reduced to atmospheric). The conductivity cells and depth sensors were last calibrated 24 months before the field trip, and the thermistors 16 months before. Since these sensors are very stable, according to the historical calibration data, we felt the last set of calibration constants was still fairly good. For the measured properties, we suggest an accuracy of 0.005°C for temperature, 0.008 mS/cm for conductivity, and 0.05 m for depth; the computed properties should have an accuracy of 0.01 ppt for salinity, 0.02 m/s for sound speed, and 0.01 kg/m^3 for σ_t.

Table 2 lists the casts made at APLIS 93. The STD plots from all casts are given in Appendix B. Figure 8 shows the STD profiles from a typical cast. The well-mixed upper layer in this case was 40 m deep, although it has extended as deep as 60 m in other years. An intrusion of warmer water from the Bering Sea lies under the mixed layer, creating a thermocline and a halocline (and therefore a pycnocline). This intrusion typically extends to a depth of 100 m. Below this is the colder Chukchi Sea water. From ~200 m down is Atlantic Water with a temperature maximum of 0.5°C. A temperature staircase is observed below 250 m with an average step change of 1–2 m and 0.01–0.02°C. The temperature and salinity profiles are presented in Figures 9a and 9b, respectively, in waterfall format to show the temporal as well as spatial variations as the floe drifted about.

The thermocline/halocline at 30–40 m depth could have had a large effect on the underwater tracking. Figure 10 shows a ray trace based on the sound speed profile of cast #22. It can be seen that there is a dearth of rays in the weak zone bounded by 2000–4500 m in range and 0–100 m in depth. A source in this zone would have been more difficult to hear through the hydrophones compared with a source outside the zone. We experienced this phenomenon when we tried and had great difficulty in obtaining the x,y fix of some hydroholes at these ranges using a pinger at various depths to 30.5 m. Tracking of submarines was generally trouble-free, as they usually stayed below 100 m depth and out of the weak zone.

Table 2. CTD casts made at APLIS 93.

Date	Time (Local)	Cast No.	Latitude	Longitude
03-29-93	1851	CAST 001	72°34.8′N	147°23.3′W
03-30-93	0649	CAST 002	72°34.5′N	147°24.2′W
03-30-93	1738	CAST 003	72°34.0′N	147°29.5′W
03-31-93	0632	CAST 004	72°34.0′N	147°39.1′W
03-31-93	2016	CAST 005	72°34.6′N	147°51.3′W
04-01-93	1613	CAST 006	72°35.9′N	148°11.2′W
04-02-93	0630	CAST 007	73°36.0′N	148°24.8′W
04-02-93	1520	CAST 008	72°35.6′N	148°32.5′W
04-02-93	1847	CAST 009	72°35.4′N	148°36.1′W
04-02-93	2229	CAST 010	72°35.2′N	148°38.9′W
04-03-93	0630	CAST 011	72°34.9′N	148°44.6′W
04-03-93	1406	CAST 012	72°34.7′N	148°52.5′W
04-03-93	2128	CAST 013	72°35.1′N	149°01.3′W
04-04-93	0610	CAST 014	72°35.6′N	149°08.5′W
04-04-93	1416	CAST 015	72°36.1′N	149°16.2′W
04-05-93	0848	CAST 016	72°36.7′N	149°28.5′W
04-05-93	1654	CAST 017	72°37.3′N	149°32.7′W
04-06-93	0934	CAST 018	72°38.1′N	149°40.7′W
04-06-93	1147	CAST 019	72°38.2′N	149°41.5′W
04-06-93	1617	CAST 020	72°38.5′N	149°44.2′W
04-06-93	2140	CAST 021	72°38.6′N	149°45.8′W
04-07-93	0751	CAST 022	72°38.5′N	149°47.5′W
04-07-93	2014	CAST 023	72°38.1′N	149°50.7′W
04-08-93	0914	CAST 024	72°37.8′N	149°51.9′W
04-08-93	1844	CAST 025	72°37.5′N	149°55.4′W
04-09-93	0831	CAST 026	72°37.3′N	149°56.5′W
04-09-93	1427	CAST 027	72°37.3′N	149°58.3′W
04-09-93	2239	CAST 028	72°36.9′N	150°02.5′W
04-10-93	1232	CAST 029	72°36.9′N	150°04.9′W
04-10-93	1750	CAST 030	72°36.9′N	150°07.3′W
04-11-93	0656	CAST 031	72°36.9′N	150°09.5′W
04-11-93	1424	CAST 032	72°36.9′N	150°10.5′W
04-11-93	2340	CAST 033	72°37.2′N	150°12.8′W
04-12-93	0746	CAST 034	72°37.4′N	150°13.8′W
04-12-93	1450	CAST 035	72°37.4′N	150°14.6′W
04-12-93	2248	CAST 036	72°37.5′N	150°16.1′W
04-13-93	0754	CAST 037	72°37.7′N	150°18.0′W
04-13-93	2320	CAST 038	72°38.0′N	150°24.0′W
04-14-93	0635	CAST 039	72°38.1′N	150°26.7′W
04-14-93	1418	CAST 040	72°38.1′N	150°30.2′W
04-14-93	2134	CAST 041	72°38.3′N	150°33.7′W
04-15-93	0621	CAST 042	72°38.8′N	150°36.1′W
04-15-93	1407	CAST 043	72°38.3′N	150°37.7′W

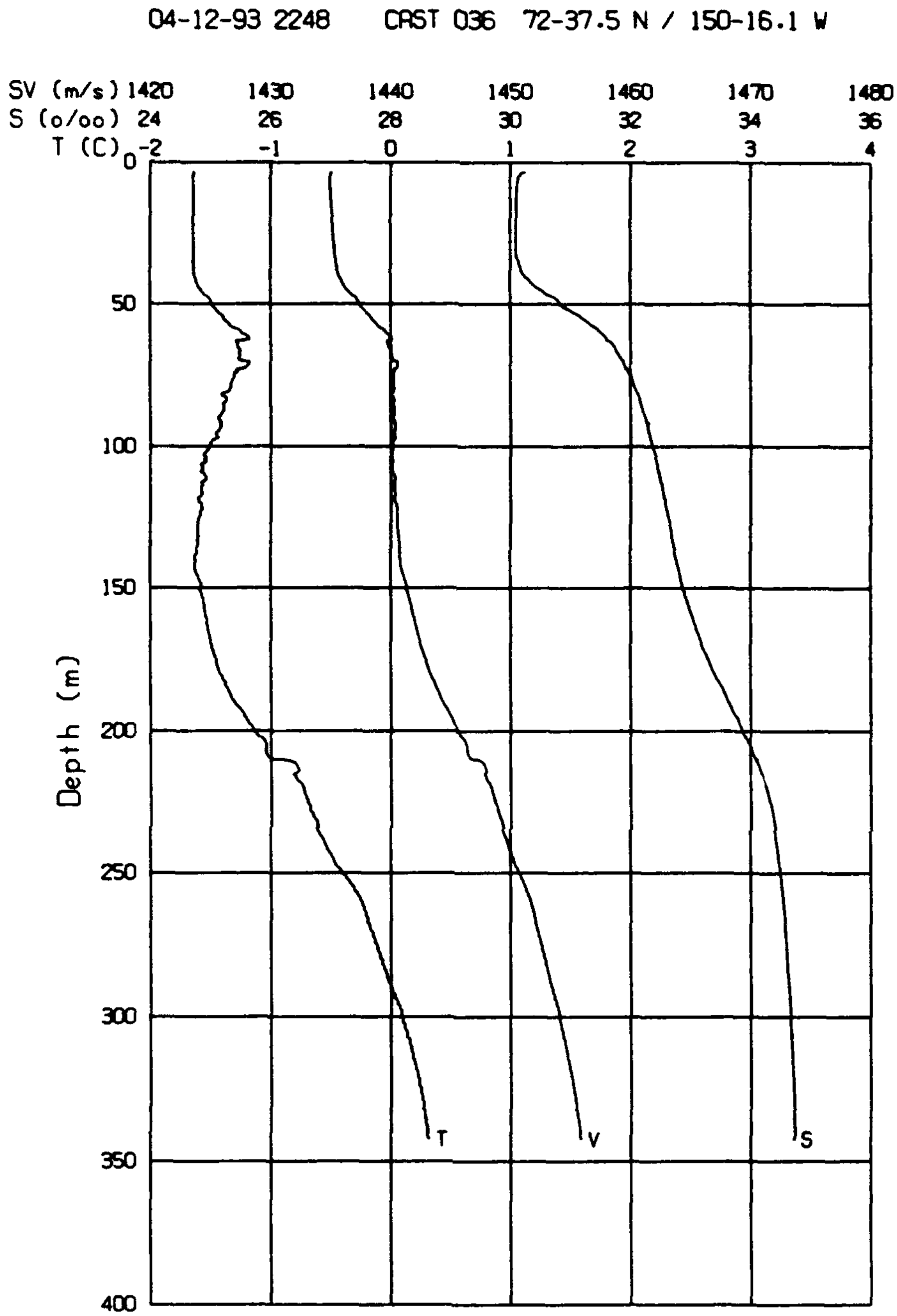

Figure 8. Sample STD profiles from cast 36 showing intrusions at 70 m and 220 m depth and temperature staircase below 250 m.

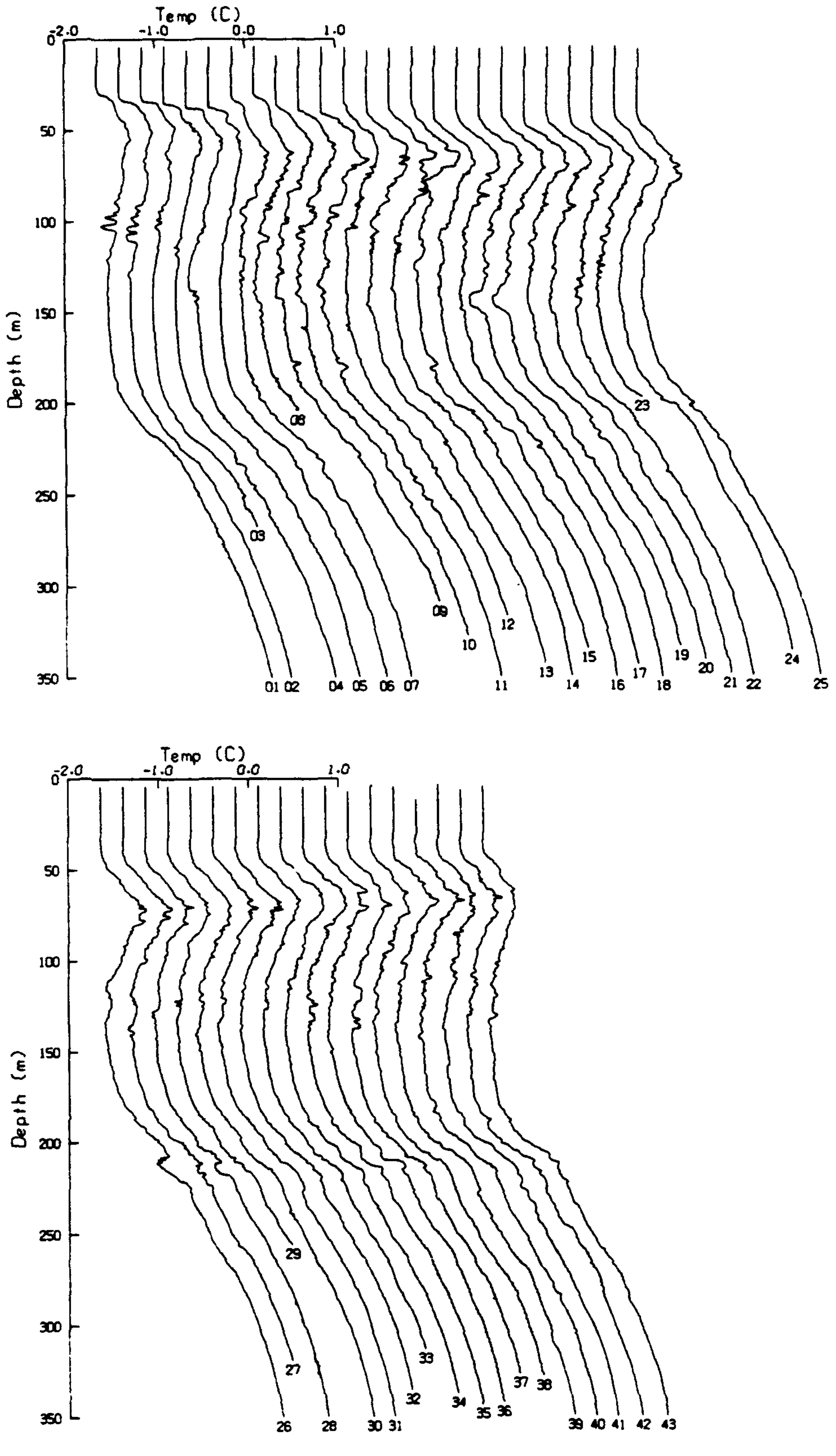

Figure 9a. Waterfall presentation of temperature profiles.

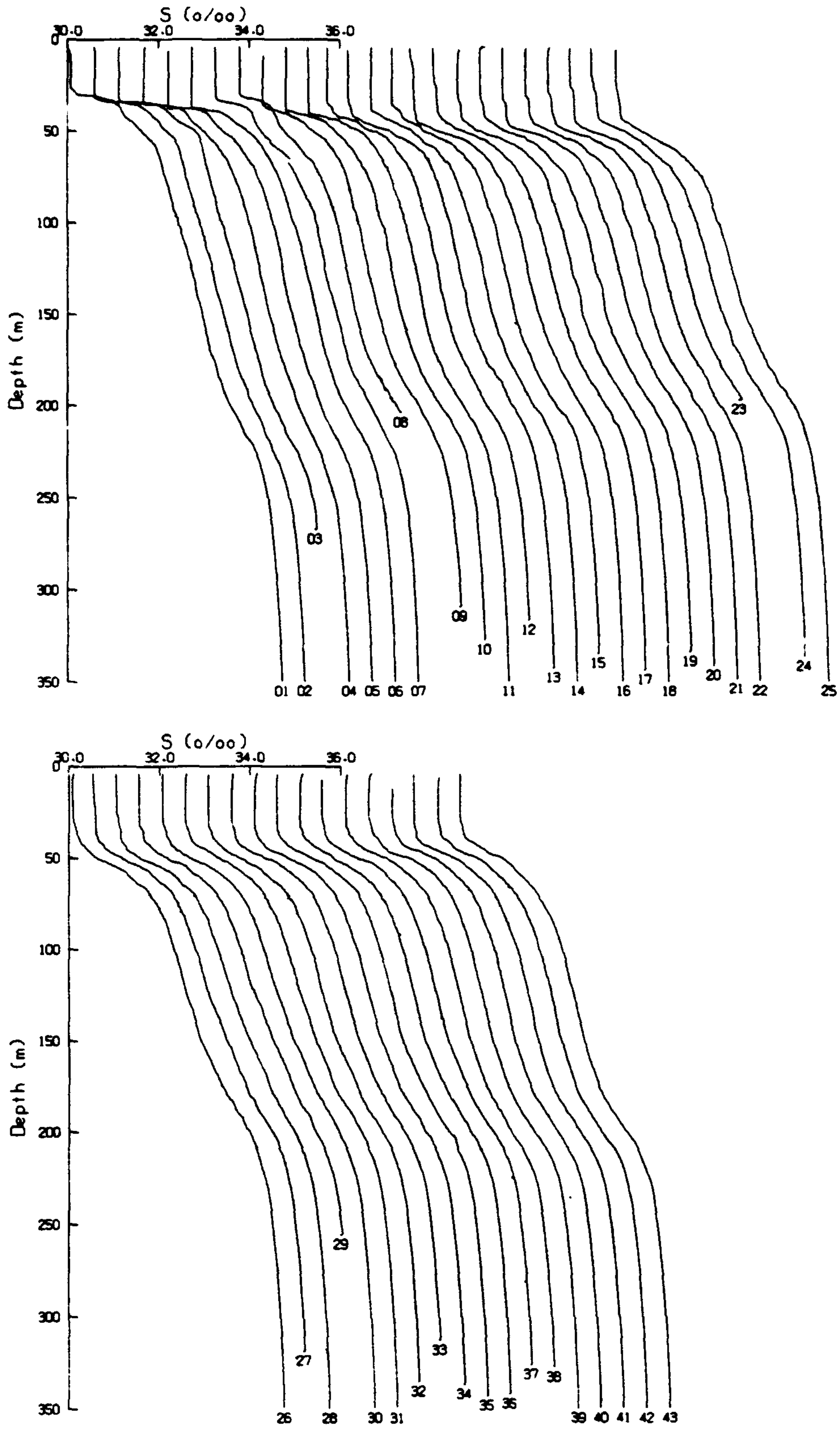

Figure 9b. Waterfall presentation of salinity profiles.

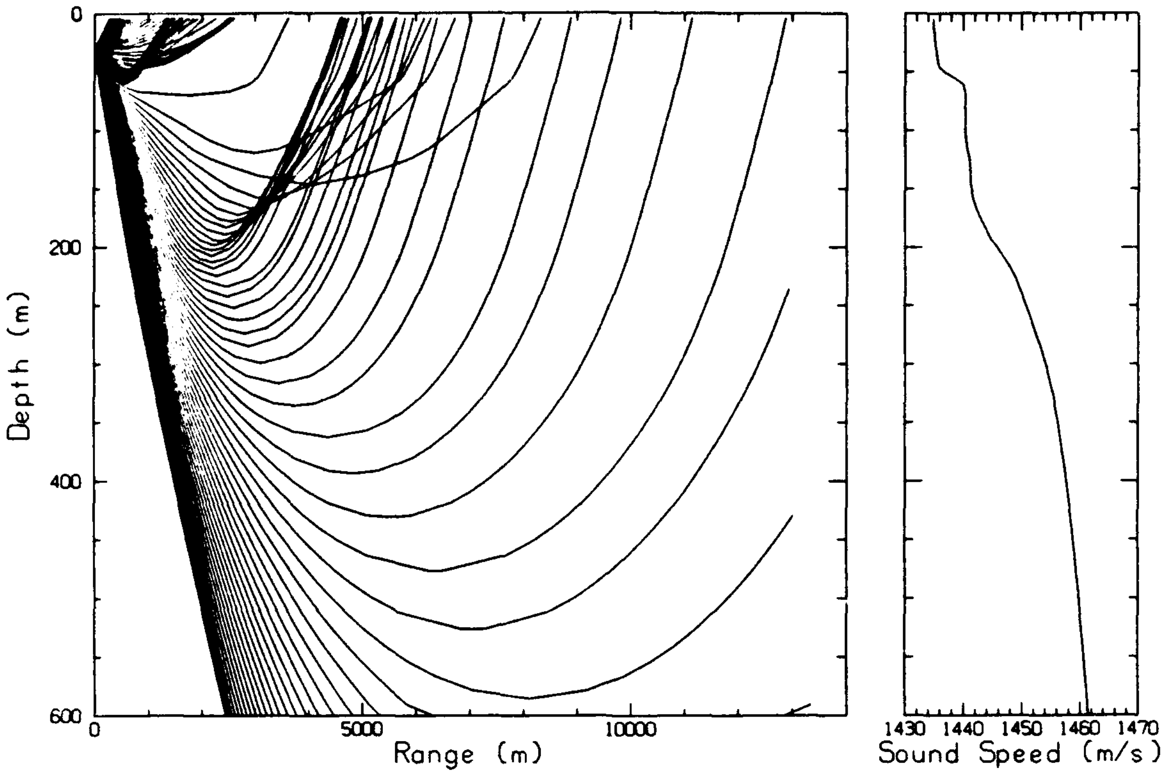

Figure 10. Ray trace showing weak zone, cast #22. Source depth at 30.5 m, rays from −15° to 5° at 0.2° increment.

VI. CURRENTS

To measure current, the CTD profiler was replaced with an InterOcean S4 current meter. A 4.5-kg lead weight was hung 1 m below the instrument to reduce streaming. The default sampling rate of the current meter was 2 Hz, but generally we recorded 5-s (10 samples) or 60-s (120 samples) averages. In addition to recording the magnetic north and east components of the current, the S4 also recorded depth. To obtain stable current measurements, we lowered the meter at depth increments of about 5–10 m, stopping for approximately 1 minute or longer at each depth. When the current meter was brought back to the surface, the data were downloaded to a computer for processing. The mean and standard deviations were computed for the data at each depth. Time series at selected depths, based on CTD information, were also made to assess the temporal variation. Table 3 lists the current meter casts. Vertical current profiles and time series data are shown in Appendix C. Both relative and absolute currents are shown for the vertical profiles, with the former plotted as a solid line and the latter dashed. Bars plotted at each depth represent plus or minus one standard deviation about the averages. In general, the currents were weak. A shear layer is observed at about 205 m in casts 3 and 4.

Table 3. Current meter casts made at APLIS 93.

mmdd	hhmm (Local)	Cast	Floe Drift Ave (s)	cm/s	Dir	Comments
0401	1635	1	60	17.3	278	
0404	1810	2	60	12.0	281	Time series at 70 m
0405	1745	3	5	10.0	295	
0408	1145	4	5	4.8	254	
0409	1645	5	5	9.9	268	
0410	1815	6	5	4.9	280	
0411	1456	7	5	5.3	289	Time series at 225 m
0413	0915	8	5	5.0	286	Time series at 220 m

VII. ICE CORE SAMPLES

Some tests were conducted in first-year ice several kilometers from the camp. The ice ranged from 0.6–1 m in thickness. Cores were taken from this ice to determine the salinity and ultimately its physical properties. Some samples were also removed for analysis from refrozen melt ponds and an ice mine.

A 7.6-cm (inside diameter) SIPRE corer was used to remove short segments about 0.5 m in length. Each segment was placed in a miter box and cut into sections 7.5 cm long. Each section was then sealed in a Ziploc bag and tagged. This procedure was repeated until the whole segment, and ultimately the whole ice column, was sampled. The temperature of each section was not measured due to difficulties in handling and the unavoidable cooling of the ice when exposed to the air during handling. Instead, a linear temperature profile in the ice was assumed by using a line defined by the surface and water temperatures. This assumption results in errors of up to 1°C and seemed reasonable based on past measurements of first-year ice. We emphasize that the temperature profile in the ice is not linear throughout the year but is close to being so at this time of year.

The samples were transported back to camp and allowed to melt at room temperature. We set up a "salinometer" with the thermistor and conductivity cell of the CTD profiler; this configuration allowed us to use the standard data-acquisition and reduction system. The sensors were mounted on a frame. The cell was tilted to avoid trapping air bubbles. A length of Tygon tubing was attached to each end of the glass tubing, which was 1 cm in diameter and 18 cm in length. The thermistor was inserted in the Tygon tubing near the conductivity cell. When the melted sample was shaken and poured into the two types of tubing and the cell, conductivity and temperature were measured simultaneously, and salinity was computed. Prior to analysis, the samples and the sensors were

placed on a bench top for several hours to bring them to the same temperature. This was necessary because any large temperature differential would have affected the conductivity results. To reduce the temperature differential further, the water sample was mixed within the cell by raising and lowering the pinched-off Tygon tubing at one end to pass the water sample back and forth.

Once the salinity of the ice was known, its other physical properties were derived using empirical models. Density, as well as brine volume, was calculated from measured salinity and assumed temperature using relationships derived by Cox and Weeks[5]. We chose not to obtain the density by weight and volume because of the problems of irregular core diameters and brine drainage. This choice also simplified the whole operation considerably by eliminating the need for weighing and measuring the core sections. Young's modulus was computed using the empirical formula of Langleben and Pounder[6].

A. First-Year Ice

Cores were taken from four test sites in the first-year ice and designated by the date of test as shown in Table 4. Plots for the properties of the cores from the first-year ice are given in Appendix D. Salinity profiles from days 4–11 are superposed and shown in Figure 11a. The profiles are typical for first-year ice: the salinity is high near the surface, owing to a faster freezing rate, and decreases as the ice grows thicker and more slowly, allowing a longer time for brine expulsion. The salinity should increase again near the bottom because the brine has not had enough time to drain out, and brine has a higher salinity (for example, 37.6 ppt at −2°C and 70.6 ppt at −4°C) than that of seawater (~30 ppt). However, the measurements show relatively low salinities near the bottom. This could be explained by brine drainage occurring during core retrieval due to seawater dilution or displacement of brine.

Table 4. Summary of ice cores.

Core No.	Thickness (cm)	Surface Temp. (°C)	Comments
4-2 #1, #2	102	−13.0	1.6 m apart
4-5 #1, #2	74	−12.7	> 2 m apart
4-6 #1, #2	76	−12.7	> 5 m apart
4-11 #1	84	−13.1	
#2, #3	85	−13.6	0.5 m apart, >10 m from #1
4-12 #1, #2	---	----	Refrozen melt ponds

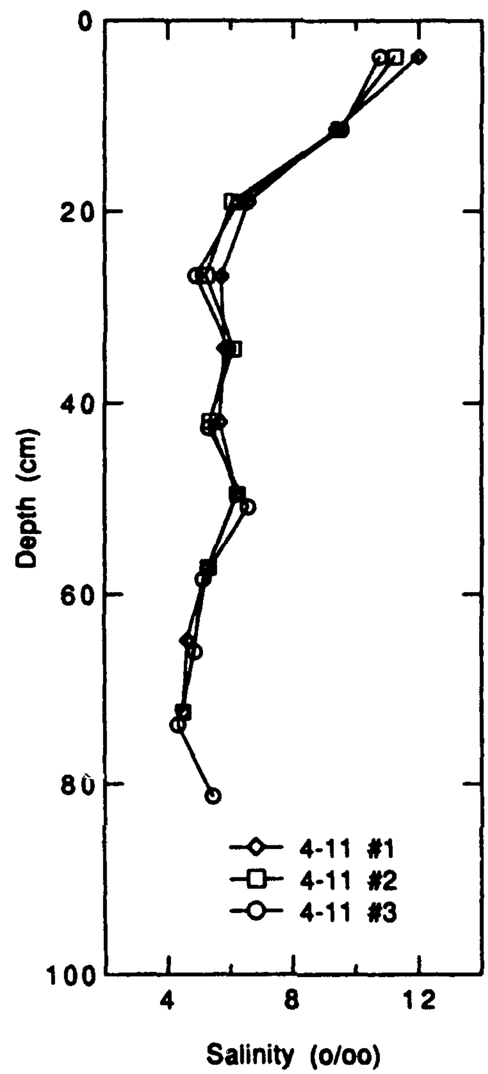

Figure 11a. Salinity profiles in first-year ice, 4-11 #1, #2, and #3 showing interprofile consistency.

Note that in the mid-ice the profile is not smooth, with the salinity varying by as much as 1 ppt from that of the ice above or below. This variation is real and not due to measurement errors, as shown by the consistency of the two cores, #2 and #3, which were taken from ice 0.5 m apart. The vertical variation can be attributed to the different freezing rates that resulted in different lengths of time available for brine drainage.

Figure 11b shows two profiles for cores 4-6 #1 and #2 from the same first-year ice with inter-profile difference of ~ 1 ppt. The cores were taken from locations over 5 m apart. Again, we believe the difference is real and not due to measurement errors, because all sampling procedures were identical and we were able to obtain nearly identical results with cores 4-11 #2 and #3. The horizontal variation in salinity is therefore most likely due to the presence of brine channels and pockets in the ice.

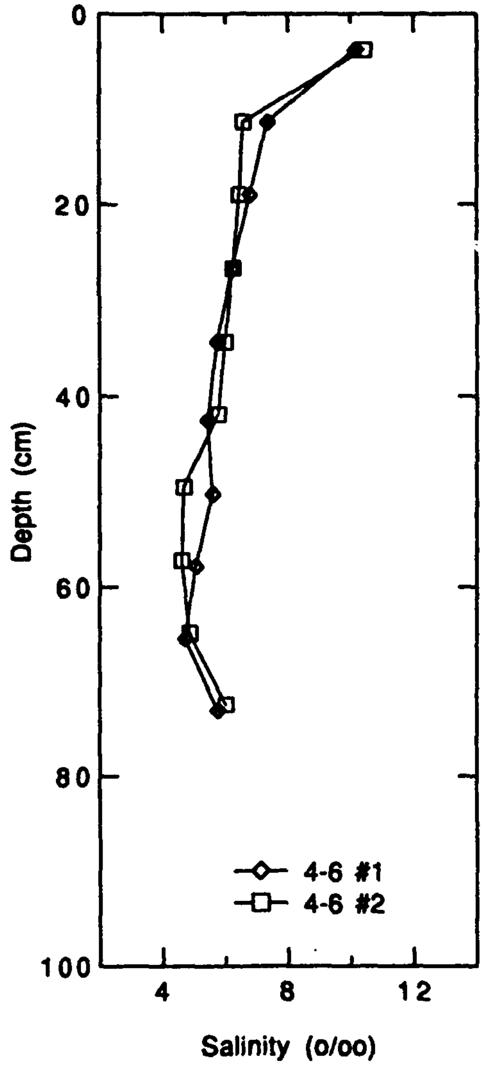

Figure 11b. Salinity profiles in first-year ice, 4-6 #1 and #2, showing interprofile variation.

B. Melt Ponds and Ice Mine

Figure 12 shows the salinity profiles from two different refrozen meltponds. The salinity is very low in the upper layer. This is expected because when meltwater from ice of 4–8 ppt freezes, an even smaller amount of salt will be trapped in the new ice. Somewhere below 20 cm the salinity jumps up to 4 ppt, comparable to that in typical ice. This tends to suggest that the depths of the melt ponds were at one time on the order of 30 cm.

We also measured the salinity of ice taken from the ice mine that was our source for drinking water. The mine was a 6-m high, well-weathered ridge at least a year old. Two samples were taken from the top of the ridge. The salinity was 0.015 ppt, almost at the noise level of our salinometer. This measurement verifies our judgement that meltwater from multiyear ridge ice tastes as good as fresh water.

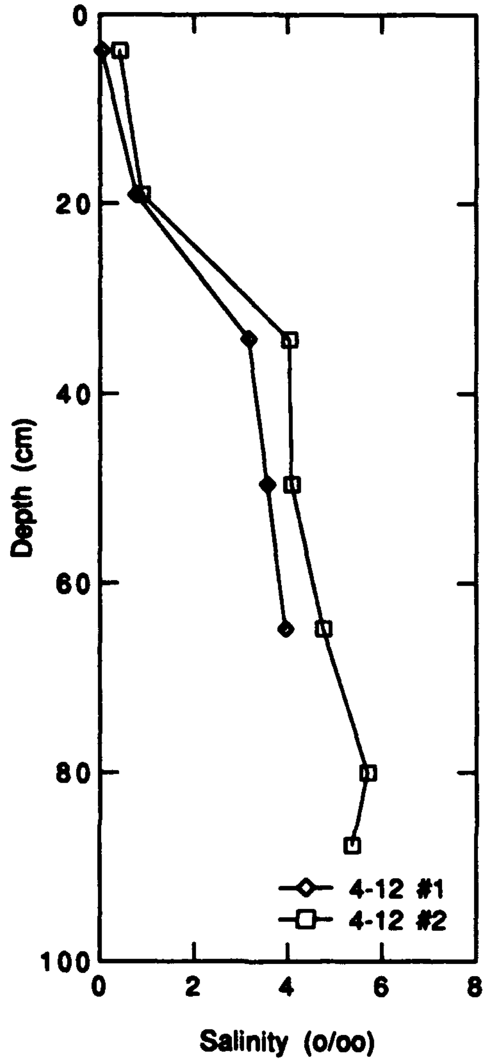

Figure 12. Salinity profiles in two different refrozen melt ponds, 4-12 #1 and #2.

VIII. REFERENCES

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APPENDIX A

Floe Position and Drift Data

(time is UTC)

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
89180000	72 34.39	147 24.66	.040	239
89183000	72 34.38	147 24.74	.112	241
89190000	72 34.36	147 24.88	.166	243
89193000	72 34.34	147 25.04	.198	245
89200000	72 34.31	147 25.22	.223	245
89203000	72 34.28	147 25.42	.245	244
89210000	72 34.25	147 25.63	.266	243
89213000	72 34.21	147 25.87	.295	243
89220000	72 34.18	147 26.14	.324	247
89223000	72 34.15	147 26.43	.342	251
89230000	72 34.12	147 26.74	.349	255
89233000	72 34.11	147 27.05	.349	259
90000000	72 34.09	147 27.36	.346	261
90003000	72 34.08	147 27.66	.346	262
90010000	72 34.06	147 27.97	.338	262
90013000	72 34.05	147 28.26	.328	261
90020000	72 34.04	147 28.53	.310	261
90023000	72 34.03	147 28.80	.302	262
90030000	72 34.02	147 29.08	.306	264
90033000	72 34.01	147 29.36	.317	265
90040000	72 34.00	147 29.66	.328	264
90043000	72 33.99	147 29.96	.331	262
90050000	72 33.97	147 30.26	.342	260
90053000	72 33.96	147 30.57	.356	259
90060000	72 33.93	147 30.91	.378	259
90063000	72 33.91	147 31.27	.403	260
90070000	72 33.90	147 31.65	.428	262
90073000	72 33.89	147 32.06	.457	266
90080000	72 33.89	147 32.49	.475	269
90083000	72 33.89	147 32.93	.486	271
90090000	72 33.89	147 33.37	.490	271
90093000	72 33.89	147 33.81	.490	271
90100000	72 33.90	147 34.25	.493	271
90103000	72 33.90	147 34.70	.497	271
90110000	72 33.91	147 35.16	.504	273
90113000	72 33.92	147 35.61	.504	275
90120000	72 33.93	147 36.06	.497	275
90123000	72 33.94	147 36.49	.486	275
90130000	72 33.95	147 36.92	.472	275
90133000	72 33.96	147 37.33	.461	275
90140000	72 33.97	147 37.75	.461	275
90143000	72 33.98	147 38.17	.475	275
90150000	72 33.99	147 38.61	.486	275
90153000	72 34.01	147 39.04	.486	275
90160000	72 34.02	147 39.47	.479	276
90163000	72 34.03	147 39.90	.472	276
90170000	72 34.05	147 40.32	.472	276
90173000	72 34.06	147 40.75	.475	277
90180000	72 34.08	147 41.17	.475	277
90183000	72 34.09	147 41.60	.475	277
90190000	72 34.11	147 42.02	.472	278
90193000	72 34.13	147 42.45	.479	278
90200000	72 34.14	147 42.89	.490	277
90203000	72 34.16	147 43.34	.500	277
90210000	72 34.18	147 43.79	.511	277
90213000	72 34.20	147 44.26	.522	278
90220000	72 34.22	147 44.74	.533	278
90223000	72 34.23	147 45.22	.540	277
90230000	72 34.25	147 45.70	.540	276
90233000	72 34.27	147 46.18	.533	277
91000000	72 34.29	147 46.65	.522	279
91003000	72 34.31	147 47.10	.511	280
91010000	72 34.34	147 47.55	.504	281

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
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91030000	72 34.44	147 49.23	.446	282
91033000	72 34.47	147 49.61	.436	282
91040000	72 34.50	147 50.01	.454	283
91043000	72 34.53	147 50.44	.490	284
91050000	72 34.56	147 50.88	.515	285
91053000	72 34.60	147 51.33	.508	285
91060000	72 34.63	147 51.76	.490	284
91063000	72 34.66	147 52.18	.479	281
91070000	72 34.68	147 52.61	.486	280
91073000	72 34.70	147 53.06	.497	280
91080000	72 34.73	147 53.50	.497	280
91083000	72 34.75	147 53.94	.497	280
91090000	72 34.77	147 54.38	.497	280
91093000	72 34.80	147 54.82	.497	280
91100000	72 34.82	147 55.26	.497	281
91103000	72 34.85	147 55.70	.500	282
91110000	72 34.88	147 56.15	.504	283
91113000	72 34.92	147 56.59	.504	283
91120000	72 34.95	147 57.03	.497	283
91123000	72 34.98	147 57.46	.490	284
91130000	72 35.01	147 57.88	.482	285
91133000	72 35.05	147 58.30	.482	286
91140000	72 35.08	147 58.72	.486	286
91143000	72 35.12	147 59.15	.493	285
91150000	72 35.15	147 59.60	.508	284
91153000	72 35.18	148 .06	.529	284
91160000	72 35.22	148 .54	.544	284
91163000	72 35.26	148 1.02	.554	285
91170000	72 35.30	148 1.52	.569	284
91173000	72 35.34	148 2.04	.590	284
91180000	72 35.38	148 2.58	.612	284
91183000	72 35.41	148 3.12	.623	283
91190000	72 35.45	148 3.67	.619	283
91193000	72 35.49	148 4.21	.616	282
91200000	72 35.52	148 4.76	.619	282
91203000	72 35.56	148 5.30	.616	283
91210000	72 35.60	148 5.83	.601	284
91213000	72 35.64	148 6.36	.608	284
91220000	72 35.68	148 6.94	.655	283
91223000	72 35.72	148 7.57	.713	282
91230000	72 35.75	148 8.23	.742	281
91233000	72 35.79	148 8.87	.716	280
92000000	72 35.82	148 9.47	.677	279
92003000	72 35.84	148 10.05	.644	279
92010000	72 35.87	148 10.61	.630	278
92013000	72 35.89	148 11.17	.623	278
92020000	72 35.91	148 11.73	.619	278
92023000	72 35.93	148 12.28	.612	278
92030000	72 35.95	148 12.82	.601	277
92033000	72 35.97	148 13.35	.594	277
92040000	72 35.99	148 13.87	.583	277
92043000	72 36.01	148 14.39	.572	277
92050000	72 36.03	148 14.88	.554	276
92053000	72 36.04	148 15.37	.540	276
92060000	72 36.05	148 15.85	.529	275
92063000	72 36.06	148 16.33	.533	274
92070000	72 36.07	148 16.82	.547	274
92073000	72 36.09	148 17.33	.565	275
92080000	72 36.10	148 17.84	.565	277
92083000	72 36.12	148 18.33	.547	277
92090000	72 36.13	148 18.81	.529	275
92093000	72 36.14	148 19.28	.518	273

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92113000	72 36.13	148 21.18	.533	267
92120000	72 36.12	148 21.66	.536	267
92123000	72 36.11	148 22.14	.529	266
92130000	72 36.09	148 22.61	.518	265
92133000	72 36.08	148 23.06	.504	264
92140000	72 36.06	148 23.50	.490	263
92143000	72 36.04	148 23.93	.475	261
92150000	72 36.02	148 24.34	.461	260
92153000	72 36.00	148 24.74	.454	259
92160000	72 35.97	148 25.14	.454	258
92163000	72 35.94	148 25.55	.461	257
92170000	72 35.92	148 25.95	.461	256
92173000	72 35.89	148 26.35	.457	256
92180000	72 35.86	148 26.75	.454	256
92183000	72 35.83	148 27.15	.457	257
92190000	72 35.81	148 27.56	.468	260
92193000	72 35.78	148 28.00	.482	261
92200000	72 35.76	148 28.45	.515	260
92203000	72 35.73	148 28.94	.544	259
92210000	72 35.70	148 29.43	.562	258
92213000	72 35.67	148 29.93	.565	258
92220000	72 35.64	148 30.43	.558	260
92223000	72 35.62	148 30.93	.562	262
92230000	72 35.60	148 31.44	.572	263
92233000	72 35.58	148 31.96	.580	263
93000000	72 35.56	148 32.48	.580	263
93003000	72 35.54	148 32.99	.569	263
93010000	72 35.52	148 33.49	.554	262
93013000	72 35.50	148 33.97	.533	262
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93033000	72 35.40	148 35.74	.490	257
93040000	72 35.37	148 36.17	.482	257
93043000	72 35.34	148 36.58	.468	257
93050000	72 35.31	148 36.98	.454	258
93053000	72 35.29	148 37.38	.446	259
93060000	72 35.27	148 37.77	.439	260
93063000	72 35.25	148 38.15	.432	260
93070000	72 35.23	148 38.54	.436	261
93073000	72 35.21	148 38.94	.446	261
93080000	72 35.19	148 39.34	.454	260
93083000	72 35.17	148 39.74	.450	260
93090000	72 35.15	148 40.13	.436	259
93093000	72 35.12	148 40.50	.421	259
93100000	72 35.10	148 40.87	.414	258
93103000	72 35.08	148 41.23	.414	258
93110000	72 35.06	148 41.60	.414	258
93113000	72 35.03	148 41.96	.410	258
93120000	72 35.01	148 42.31	.403	257
93123000	72 34.99	148 42.66	.389	257
93130000	72 34.96	148 42.99	.374	257
93133000	72 34.94	148 43.30	.360	257
93140000	72 34.92	148 43.62	.360	258
93143000	72 34.90	148 43.95	.371	260
93150000	72 34.89	148 44.30	.385	262
93153000	72 34.87	148 44.66	.403	262
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93163000	72 34.83	148 45.41	.436	259
93170000	72 34.81	148 45.82	.457	257
93173000	72 34.78	148 46.25	.490	258
93180000	72 34.75	148 46.71	.526	259

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
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93193000	72 34.68	148 48.28	.608	263
93200000	72 34.67	148 48.85	.626	265
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93210000	72 34.66	148 50.02	.659	269
93213000	72 34.66	148 50.63	.670	271
93220000	72 34.67	148 51.24	.680	272
93223000	72 34.68	148 51.86	.688	273
93230000	72 34.69	148 52.49	.698	274
93233000	72 34.71	148 53.12	.706	275
94000000	72 34.72	148 53.76	.709	275
94003000	72 34.74	148 54.40	.709	276
94010000	72 34.76	148 55.03	.706	276
94013000	72 34.79	148 55.66	.702	277
94020000	72 34.82	148 56.28	.695	278
94023000	72 34.85	148 56.89	.684	280
94030000	72 34.88	148 57.49	.677	280
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94050000	72 35.01	148 59.82	.637	281
94053000	72 35.04	149 .37	.612	281
94060000	72 35.07	149 .89	.594	282
94063000	72 35.11	149 1.41	.590	283
94070000	72 35.15	149 1.94	.598	284
94073000	72 35.19	149 2.47	.601	284
94080000	72 35.23	149 2.98	.587	286
94083000	72 35.27	149 3.46	.562	287
94090000	72 35.32	149 3.92	.536	288
94093000	72 35.36	149 4.37	.518	288
94100000	72 35.40	149 4.80	.500	288
94103000	72 35.44	149 5.22	.490	287
94110000	72 35.48	149 5.64	.479	286
94113000	72 35.51	149 6.05	.468	286
94120000	72 35.55	149 6.45	.457	285
94123000	72 35.58	149 6.84	.450	284
94130000	72 35.60	149 7.24	.446	282
94133000	72 35.62	149 7.64	.450	280
94140000	72 35.64	149 8.05	.457	278
94143000	72 35.66	149 8.46	.461	277
94150000	72 35.67	149 8.87	.461	276
94153000	72 35.68	149 9.29	.457	275
94160000	72 35.69	149 9.70	.464	276
94163000	72 35.71	149 10.13	.475	277
94170000	72 35.73	149 10.57	.493	279
94173000	72 35.76	149 11.02	.515	281
94180000	72 35.79	149 11.50	.540	282
94183000	72 35.82	149 12.00	.569	283
94190000	72 35.86	149 12.52	.590	284
94193000	72 35.90	149 13.05	.605	283
94200000	72 35.94	149 13.59	.616	283
94203000	72 35.97	149 14.14	.616	283
94210000	72 36.01	149 14.67	.605	284
94213000	72 36.05	149 15.19	.594	285
94220000	72 36.10	149 15.69	.587	286
94223000	72 36.14	149 16.20	.583	286
94230000	72 36.18	149 16.70	.576	286
94233000	72 36.23	149 17.19	.565	286
95000000	72 36.27	149 17.67	.551	286
95003000	72 36.31	149 18.14	.536	285
95010000	72 36.34	149 18.60	.522	284
95013000	72 36.37	149 19.04	.500	283
95020000	72 36.40	149 19.46	.475	282
95023000	72 36.42	149 19.86	.454	282

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
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95033000	72 36.47	149 20.61	.418	281
95040000	72 36.49	149 20.97	.407	281
95043000	72 36.51	149 21.33	.400	280
95050000	72 36.53	149 21.68	.392	280
95053000	72 36.55	149 22.02	.382	281
95060000	72 36.57	149 22.35	.371	283
95063000	72 36.59	149 22.67	.360	283
95070000	72 36.61	149 22.98	.356	283
95073000	72 36.64	149 23.30	.360	282
95080000	72 36.65	149 23.63	.371	281
95083000	72 36.67	149 23.97	.385	279
95090000	72 36.69	149 24.32	.389	278
95093000	72 36.70	149 24.66	.382	278
95100000	72 36.72	149 24.99	.367	280
95103000	72 36.74	149 25.30	.356	281
95110000	72 36.75	149 25.61	.342	282
95113000	72 36.77	149 25.90	.331	281
95120000	72 36.79	149 26.19	.324	281
95123000	72 36.80	149 26.47	.313	281
95130000	72 36.82	149 26.74	.299	283
95133000	72 36.84	149 26.99	.288	284
95140000	72 36.86	149 27.23	.277	285
95143000	72 36.88	149 27.46	.270	286
95150000	72 36.90	149 27.69	.263	287
95153000	72 36.92	149 27.91	.248	287
95160000	72 36.94	149 28.11	.234	286
95163000	72 36.95	149 28.31	.223	285
95170000	72 36.97	149 28.50	.227	283
95173000	72 36.98	149 28.72	.245	282
95180000	72 37.00	149 28.96	.266	282
95183000	72 37.02	149 29.21	.281	284
95190000	72 37.04	149 29.46	.288	285
95193000	72 37.06	149 29.71	.292	285
95200000	72 37.08	149 29.98	.306	285
95203000	72 37.10	149 30.26	.328	286
95210000	72 37.13	149 30.57	.353	288
95213000	72 37.17	149 30.89	.382	290
95220000	72 37.20	149 31.24	.403	290
95223000	72 37.24	149 31.59	.418	289
95230000	72 37.28	149 31.96	.428	289
95233000	72 37.32	149 32.33	.432	289
96000000	72 37.36	149 32.70	.432	291
96003000	72 37.40	149 33.05	.428	292
96010000	72 37.45	149 33.40	.414	293
96013000	72 37.49	149 33.72	.396	294
96020000	72 37.53	149 34.04	.382	294
96023000	72 37.57	149 34.35	.371	294
96030000	72 37.61	149 34.64	.360	295
96033000	72 37.65	149 34.92	.342	295
96040000	72 37.69	149 35.18	.317	295
96043000	72 37.72	149 35.42	.292	295
96050000	72 37.75	149 35.64	.274	295
96053000	72 37.78	149 35.86	.266	294
96060000	72 37.81	149 36.08	.259	293
96063000	72 37.83	149 36.29	.252	291
96070000	72 37.85	149 36.51	.248	287
96073000	72 37.87	149 36.73	.256	285
96080000	72 37.89	149 36.97	.277	286
96083000	72 37.92	149 37.23	.302	289
96090000	72 37.95	149 37.50	.313	291
96093000	72 37.98	149 37.76	.310	289
96100000	72 38.00	149 38.03	.302	285
96103000	72 38.01	149 38.29	.299	281
96110000	72 38.02	149 38.55	.292	279

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
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96120000	72 38.05	149 39.03	.256	281
96123000	72 38.06	149 39.23	.227	282
96130000	72 38.07	149 39.41	.202	283
96133000	72 38.09	149 39.57	.184	282
96140000	72 38.09	149 39.73	.173	281
96143000	72 38.10	149 39.88	.173	280
96150000	72 38.11	149 40.04	.176	282
96153000	72 38.12	149 40.19	.169	286
96160000	72 38.14	149 40.32	.151	288
96163000	72 38.15	149 40.44	.140	286
96170000	72 38.16	149 40.56	.140	282
96173000	72 38.16	149 40.70	.151	279
96180000	72 38.17	149 40.85	.162	280
96183000	72 38.18	149 41.00	.176	284
96190000	72 38.20	149 41.17	.194	286
96193000	72 38.21	149 41.37	.227	285
96200000	72 38.23	149 41.60	.263	283
96203000	72 38.25	149 41.86	.295	283
96210000	72 38.27	149 42.14	.313	285
96213000	72 38.29	149 42.42	.320	287
96220000	72 38.32	149 42.70	.328	288
96223000	72 38.35	149 42.99	.338	288
96230000	72 38.38	149 43.29	.349	287
96233000	72 38.40	149 43.59	.349	287
97000000	72 38.43	149 43.89	.342	287
97003000	72 38.45	149 44.18	.328	287
97010000	72 38.48	149 44.44	.310	286
97013000	72 38.50	149 44.69	.281	286
97020000	72 38.52	149 44.90	.245	287
97023000	72 38.53	149 45.08	.209	288
97030000	72 38.55	149 45.23	.180	289
97033000	72 38.56	149 45.37	.155	288
97040000	72 38.57	149 45.48	.137	288
97043000	72 38.58	149 45.58	.119	288
97050000	72 38.59	149 45.67	.104	290
97053000	72 38.60	149 45.76	.097	290
97060000	72 38.61	149 45.84	.094	287
97063000	72 38.61	149 45.91	.086	280
97070000	72 38.62	149 45.99	.083	274
97073000	72 38.62	149 46.07	.086	275
97080000	72 38.62	149 46.16	.097	277
97083000	72 38.62	149 46.25	.108	275
97090000	72 38.62	149 46.35	.112	271
97093000	72 38.62	149 46.45	.108	271
97100000	72 38.63	149 46.55	.108	274
97103000	72 38.63	149 46.65	.115	275
97110000	72 38.63	149 46.76	.119	271
97113000	72 38.63	149 46.86	.112	262
97120000	72 38.62	149 46.95	.108	253
97123000	72 38.61	149 47.04	.101	247
97130000	72 38.59	149 47.12	.101	245
97133000	72 38.58	149 47.21	.104	243
97140000	72 38.57	149 47.29	.112	237
97143000	72 38.55	149 47.37	.112	230
97150000	72 38.52	149 47.44	.108	222
97153000	72 38.50	149 47.49	.101	215
97160000	72 38.48	149 47.53	.094	209
97163000	72 38.46	149 47.56	.079	205
97170000	72 38.44	149 47.58	.068	204
97173000	72 38.43	149 47.62	.065	214
97180000	72 38.42	149 47.67	.072	230
97183000	72 38.41	149 47.74	.086	243
97190000	72 38.40	149 47.82	.094	251
97193000	72 38.39	149 47.91	.101	258

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
97200000	72 38.39	149 48.01	.112	264
97203000	72 38.38	149 48.13	.130	264
97210000	72 38.38	149 48.26	.148	261
97213000	72 38.37	149 48.40	.162	259
97220000	72 38.36	149 48.55	.173	258
97223000	72 38.35	149 48.72	.191	258
97230000	72 38.34	149 48.91	.209	259
97233000	72 38.33	149 49.12	.230	262
98000000	72 38.32	149 49.35	.252	264
98003000	72 38.32	149 49.58	.263	263
98010000	72 38.30	149 49.80	.252	260
98013000	72 38.29	149 50.00	.227	257
98020000	72 38.27	149 50.17	.198	254
98023000	72 38.26	149 50.32	.173	250
98030000	72 38.24	149 50.44	.155	241
98033000	72 38.21	149 50.55	.151	230
98040000	72 38.18	149 50.63	.144	219
98043000	72 38.15	149 50.69	.137	211
98050000	72 38.12	149 50.74	.122	207
98053000	72 38.09	149 50.79	.112	209
98060000	72 38.07	149 50.84	.101	212
98063000	72 38.05	149 50.88	.086	213
98070000	72 38.03	149 50.92	.072	215
98073000	72 38.02	149 50.96	.061	227
98080000	72 38.02	149 51.01	.058	246
98083000	72 38.01	149 51.07	.061	258
98090000	72 38.01	149 51.12	.065	261
98093000	72 38.01	149 51.18	.061	262
98100000	72 38.01	149 51.24	.065	266
98103000	72 38.01	149 51.31	.079	270
98110000	72 38.01	149 51.39	.094	272
98113000	72 38.01	149 51.48	.101	271
98120000	72 38.01	149 51.56	.090	262
98123000	72 38.00	149 51.63	.079	241
98130000	72 37.98	149 51.67	.086	217
98133000	72 37.95	149 51.71	.097	207
98140000	72 37.93	149 51.75	.097	207
98143000	72 37.91	149 51.80	.090	212
98150000	72 37.89	149 51.84	.086	216
98153000	72 37.87	149 51.88	.086	213
98160000	72 37.85	149 51.92	.090	206
98163000	72 37.83	149 51.95	.094	201
98170000	72 37.80	149 51.98	.097	202
98173000	72 37.78	149 52.02	.097	204
98180000	72 37.75	149 52.06	.097	206
98183000	72 37.73	149 52.10	.094	212
98190000	72 37.71	149 52.16	.097	223
98193000	72 37.70	149 52.24	.112	236
98200000	72 37.68	149 52.36	.137	244
98203000	72 37.67	149 52.49	.155	250
98210000	72 37.65	149 52.64	.173	254
98213000	72 37.64	149 52.81	.194	258
98220000	72 37.63	149 53.00	.212	260
98223000	72 37.62	149 53.21	.230	260
98230000	72 37.61	149 53.42	.241	260
98233000	72 37.60	149 53.65	.256	260
99000000	72 37.59	149 53.89	.266	260
99003000	72 37.57	149 54.13	.277	259
99010000	72 37.56	149 54.39	.284	259
99013000	72 37.54	149 54.65	.292	259
99020000	72 37.52	149 54.90	.292	258
99023000	72 37.51	149 55.15	.281	256
99030000	72 37.49	149 55.38	.259	253
99033000	72 37.47	149 55.57	.230	251
99040000	72 37.45	149 55.74	.198	250

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
99043000	72 37.43	149 55.89	.169	250
99050000	72 37.42	149 56.01	.140	247
99053000	72 37.40	149 56.09	.115	240
99060000	72 37.39	149 56.16	.090	231
99063000	72 37.37	149 56.20	.068	222
99070000	72 37.36	149 56.22	.050	216
99073000	72 37.35	149 56.24	.036	211
99080000	72 37.35	149 56.25	.025	205
99083000	72 37.34	149 56.25	.014	-99
99090000	72 37.34	149 56.25	.007	-99
99093000	72 37.35	149 56.24	.011	-99
99100000	72 37.35	149 56.24	.007	-99
99103000	72 37.35	149 56.26	.011	277
99110000	72 37.35	149 56.27	.018	252
99113000	72 37.34	149 56.29	.025	243
99120000	72 37.34	149 56.32	.040	243
99123000	72 37.33	149 56.36	.047	247
99130000	72 37.33	149 56.39	.043	253
99133000	72 37.33	149 56.42	.029	266
99140000	72 37.33	149 56.43	.014	296
99143000	72 37.33	149 56.44	.011	316
99150000	72 37.33	149 56.45	.011	276
99153000	72 37.33	149 56.47	.025	257
99160000	72 37.33	149 56.50	.040	255
99163000	72 37.33	149 56.54	.047	252
99170000	72 37.32	149 56.59	.058	243
99173000	72 37.31	149 56.65	.079	233
99180000	72 37.29	149 56.72	.104	230
99183000	72 37.27	149 56.81	.133	232
99190000	72 37.24	149 56.93	.155	236
99193000	72 37.22	149 57.07	.184	239
99200000	72 37.19	149 57.24	.212	241
99203000	72 37.16	149 57.43	.234	244
99210000	72 37.14	149 57.65	.252	248
99213000	72 37.11	149 57.88	.270	253
99220000	72 37.09	149 58.14	.292	256
99223000	72 37.08	149 58.42	.313	259
99230000	72 37.07	149 58.72	.335	263
99233000	72 37.06	149 59.03	.349	266
100000000	72 37.06	149 59.35	.356	268
100003000	72 37.05	149 59.68	.360	268
100010000	72 37.05	150 .01	.364	268
100013000	72 37.05	150 .34	.364	268
100020000	72 37.04	150 .66	.356	268
100023000	72 37.04	150 .97	.346	268
100030000	72 37.03	150 1.27	.324	266
100033000	72 37.03	150 1.53	.288	265
100040000	72 37.02	150 1.75	.252	265
100043000	72 37.02	150 1.95	.212	265
100050000	72 37.01	150 2.11	.180	263
100053000	72 37.00	150 2.24	.148	257
100060000	72 36.99	150 2.34	.112	250
100063000	72 36.98	150 2.40	.076	242
100070000	72 36.97	150 2.42	.040	231
100073000	72 36.97	150 2.44	.018	226
100080000	72 36.97	150 2.45	.014	258
100083000	72 36.97	150 2.47	.029	276
100090000	72 36.97	150 2.52	.047	273
100093000	72 36.97	150 2.57	.065	269
100100000	72 36.97	150 2.64	.072	267
100103000	72 36.97	150 2.71	.083	266
100110000	72 36.97	150 2.79	.086	268
100113000	72 36.97	150 2.87	.090	270
100120000	72 36.97	150 2.95	.090	273
100123000	72 36.97	150 3.04	.090	275

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
100130000	72 36.97	150 3.12	.097	274
100133000	72 36.97	150 3.23	.115	273
100140000	72 36.98	150 3.35	.133	273
100143000	72 36.98	150 3.48	.144	272
100150000	72 36.98	150 3.61	.148	268
100153000	72 36.97	150 3.74	.140	263
100160000	72 36.96	150 3.86	.133	259
100163000	72 36.96	150 3.97	.126	258
100170000	72 36.95	150 4.07	.115	259
100173000	72 36.95	150 4.16	.101	261
100180000	72 36.94	150 4.25	.097	265
100183000	72 36.94	150 4.34	.101	268
100190000	72 36.94	150 4.44	.115	267
100193000	72 36.94	150 4.56	.133	263
100200000	72 36.93	150 4.70	.158	261
100203000	72 36.92	150 4.87	.184	261
100210000	72 36.91	150 5.05	.205	261
100213000	72 36.90	150 5.26	.230	261
100220000	72 36.90	150 5.48	.252	263
100223000	72 36.89	150 5.72	.266	264
100230000	72 36.88	150 5.97	.270	266
100233000	72 36.88	150 6.22	.274	267
101000000	72 36.88	150 6.47	.281	268
101003000	72 36.88	150 6.73	.288	268
101010000	72 36.87	150 6.99	.284	269
101013000	72 36.87	150 7.23	.274	270
101020000	72 36.88	150 7.46	.256	272
101023000	72 36.88	150 7.67	.230	274
101030000	72 36.89	150 7.86	.205	277
101033000	72 36.90	150 8.01	.176	280
101040000	72 36.90	150 8.14	.148	282
101043000	72 36.91	150 8.25	.122	284
101050000	72 36.92	150 8.33	.090	285
101053000	72 36.92	150 8.38	.058	284
101060000	72 36.92	150 8.41	.032	276
101063000	72 36.92	150 8.43	.022	273
101070000	72 36.92	150 8.45	.022	286
101073000	72 36.93	150 8.48	.029	286
101080000	72 36.93	150 8.51	.040	271
101083000	72 36.92	150 8.56	.054	256
101090000	72 36.92	150 8.62	.065	251
101093000	72 36.91	150 8.67	.065	254
101100000	72 36.91	150 8.73	.065	265
101103000	72 36.91	150 8.80	.076	277
101110000	72 36.92	150 8.87	.086	284
101113000	72 36.93	150 8.96	.097	288
101120000	72 36.94	150 9.04	.097	290
101123000	72 36.94	150 9.11	.086	289
101130000	72 36.95	150 9.18	.076	281
101133000	72 36.95	150 9.25	.072	270
101140000	72 36.95	150 9.32	.076	267
101143000	72 36.95	150 9.39	.083	274
101150000	72 36.95	150 9.47	.086	283
101153000	72 36.96	150 9.53	.076	287
101160000	72 36.96	150 9.59	.061	281
101163000	72 36.96	150 9.64	.058	266
101170000	72 36.96	150 9.69	.061	255
101173000	72 36.95	150 9.75	.065	250
101180000	72 36.95	150 9.81	.068	245
101183000	72 36.94	150 9.86	.068	240
101190000	72 36.93	150 9.91	.065	241
101193000	72 36.92	150 9.96	.065	250
101200000	72 36.92	150 10.03	.072	263
101203000	72 36.92	150 10.10	.079	271
101210000	72 36.92	150 10.18	.090	276

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
101213000	72 36.93	150 10.27	.101	280
101220000	72 36.93	150 10.37	.115	284
101223000	72 36.94	150 10.49	.137	287
101230000	72 36.96	150 10.63	.158	289
101233000	72 36.97	150 10.78	.180	289
102000000	72 36.99	150 10.94	.191	289
102003000	72 37.01	150 11.10	.187	290
102010000	72 37.02	150 11.25	.176	290
102013000	72 37.04	150 11.39	.162	289
102020000	72 37.05	150 11.53	.158	288
102023000	72 37.07	150 11.66	.151	289
102030000	72 37.08	150 11.78	.148	291
102033000	72 37.09	150 11.90	.140	292
102040000	72 37.11	150 12.01	.133	292
102043000	72 37.12	150 12.12	.130	293
102050000	72 37.14	150 12.22	.130	296
102053000	72 37.15	150 12.32	.119	298
102060000	72 37.17	150 12.40	.104	297
102063000	72 37.17	150 12.48	.090	292
102070000	72 37.18	150 12.55	.086	289
102073000	72 37.19	150 12.63	.090	289
102080000	72 37.20	150 12.71	.094	294
102083000	72 37.21	150 12.78	.097	302
102090000	72 37.23	150 12.85	.101	311
102093000	72 37.25	150 12.92	.108	314
102100000	72 37.27	150 13.00	.119	312
102103000	72 37.29	150 13.09	.122	308
102110000	72 37.31	150 13.18	.122	305
102113000	72 37.33	150 13.26	.115	303
102120000	72 37.34	150 13.35	.104	301
102123000	72 37.36	150 13.42	.097	300
102130000	72 37.37	150 13.50	.094	301
102133000	72 37.38	150 13.57	.090	301
102140000	72 37.40	150 13.63	.086	300
102143000	72 37.41	150 13.70	.083	297
102150000	72 37.41	150 13.76	.076	293
102153000	72 37.42	150 13.82	.065	292
102160000	72 37.43	150 13.86	.058	297
102163000	72 37.44	150 13.91	.058	303
102170000	72 37.44	150 13.95	.058	302
102173000	72 37.45	150 14.00	.054	290
102180000	72 37.45	150 14.05	.058	276
102183000	72 37.45	150 14.11	.061	270
102190000	72 37.45	150 14.16	.061	271
102193000	72 37.45	150 14.21	.058	278
102200000	72 37.46	150 14.26	.050	286
102203000	72 37.46	150 14.30	.047	284
102210000	72 37.46	150 14.35	.050	271
102213000	72 37.46	150 14.41	.065	262
102220000	72 37.45	150 14.48	.086	262
102223000	72 37.45	150 14.57	.101	264
102230000	72 37.45	150 14.67	.104	267
102233000	72 37.45	150 14.75	.097	268
103000000	72 37.45	150 14.84	.094	268
103003000	72 37.45	150 14.92	.094	268
103010000	72 37.45	150 15.01	.094	271
103013000	72 37.45	150 15.09	.094	277
103020000	72 37.46	150 15.18	.097	283
103023000	72 37.46	150 15.27	.101	285
103030000	72 37.47	150 15.36	.104	285
103033000	72 37.48	150 15.45	.104	284
103040000	72 37.48	150 15.54	.101	282
103043000	72 37.49	150 15.63	.101	278
103050000	72 37.49	150 15.72	.101	277
103053000	72 37.50	150 15.80	.097	280
103060000	72 37.50	150 15.89	.101	286

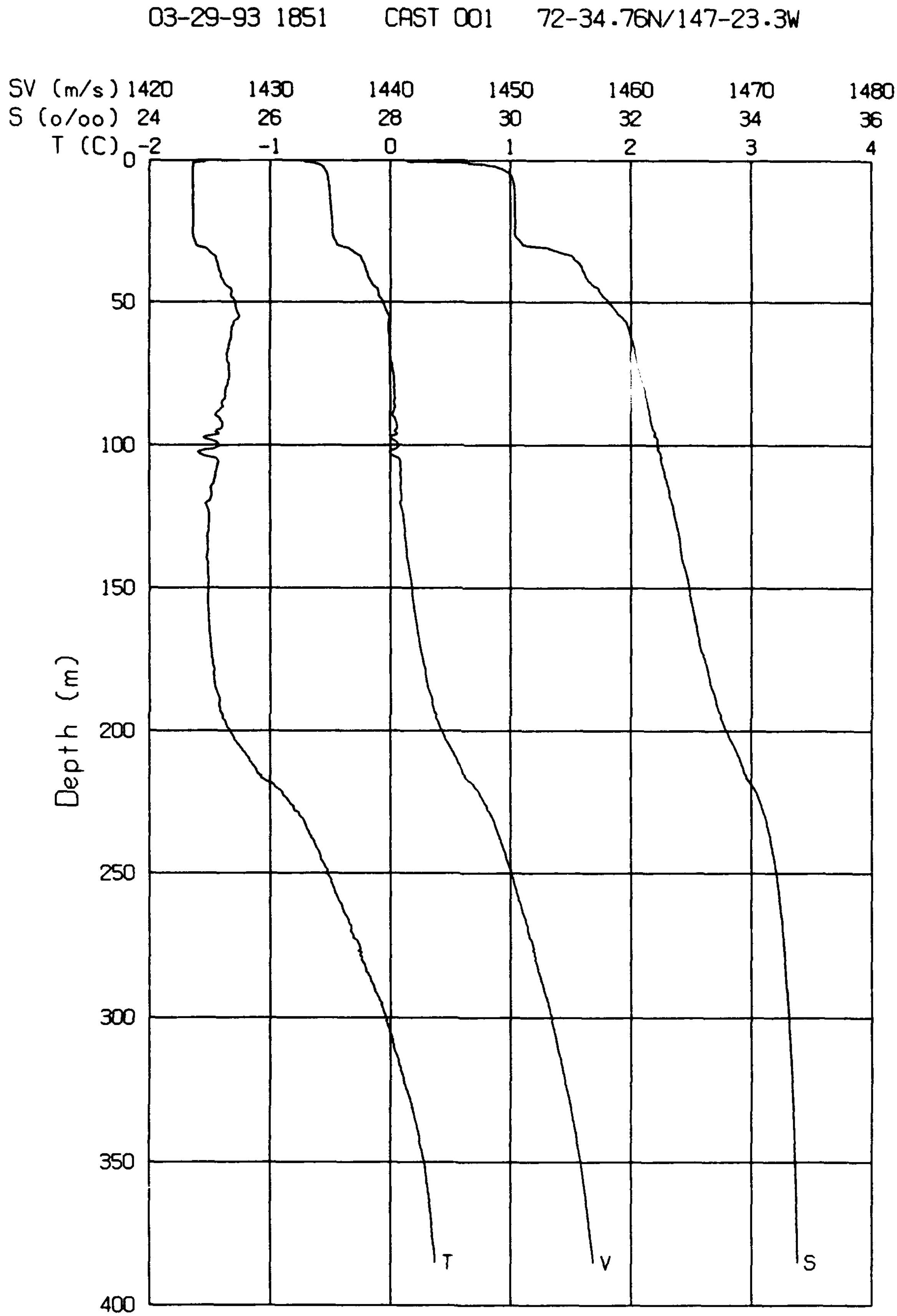
Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
103063000	72 37.51	150 15.99	.112	290
103070000	72 37.53	150 16.09	.126	291
103073000	72 37.54	150 16.21	.137	289
103080000	72 37.55	150 16.33	.133	287
103083000	72 37.56	150 16.43	.126	289
103090000	72 37.57	150 16.53	.119	292
103093000	72 37.58	150 16.63	.115	290
103100000	72 37.59	150 16.74	.119	284
103103000	72 37.59	150 16.85	.122	278
103110000	72 37.60	150 16.96	.119	276
103113000	72 37.60	150 17.06	.115	277
103120000	72 37.61	150 17.16	.112	281
103123000	72 37.61	150 17.26	.115	284
103130000	72 37.62	150 17.36	.119	284
103133000	72 37.63	150 17.47	.126	283
103140000	72 37.64	150 17.58	.126	284
103143000	72 37.65	150 17.69	.126	285
103150000	72 37.66	150 17.80	.130	287
103153000	72 37.67	150 17.92	.130	288
103160000	72 37.68	150 18.03	.137	289
103163000	72 37.69	150 18.16	.144	289
103170000	72 37.71	150 18.29	.151	288
103173000	72 37.72	150 18.43	.162	288
103180000	72 37.73	150 18.58	.173	288
103183000	72 37.75	150 18.73	.180	286
103190000	72 37.76	150 18.90	.187	285
103193000	72 37.77	150 19.06	.191	283
103200000	72 37.78	150 19.24	.194	280
103203000	72 37.79	150 19.42	.202	277
103210000	72 37.79	150 19.61	.212	276
103213000	72 37.80	150 19.80	.216	277
103220000	72 37.81	150 20.00	.216	279
103223000	72 37.82	150 20.20	.223	280
103230000	72 37.83	150 20.41	.238	281
103233000	72 37.85	150 20.64	.256	281
104000000	72 37.86	150 20.87	.266	282
104003000	72 37.88	150 21.11	.266	282
104010000	72 37.89	150 21.34	.263	282
104013000	72 37.90	150 21.57	.259	282
104020000	72 37.92	150 21.80	.256	283
104023000	72 37.94	150 22.02	.256	284
104030000	72 37.96	150 22.24	.252	285
104033000	72 37.97	150 22.46	.245	284
104040000	72 37.98	150 22.67	.238	281
104043000	72 37.99	150 22.88	.238	279
104050000	72 38.00	150 23.09	.238	279
104053000	72 38.01	150 23.30	.230	279
104060000	72 38.02	150 23.49	.220	279
104063000	72 38.03	150 23.68	.205	279
104070000	72 38.04	150 23.85	.198	277
104073000	72 38.04	150 24.03	.198	275
104080000	72 38.05	150 24.22	.202	273
104083000	72 38.05	150 24.41	.212	271
104090000	72 38.05	150 24.61	.220	270
104093000	72 38.05	150 24.81	.227	269
104100000	72 38.04	150 25.02	.227	268
104103000	72 38.04	150 25.22	.223	268
104110000	72 38.04	150 25.42	.220	270
104113000	72 38.04	150 25.62	.216	273
104120000	72 38.05	150 25.81	.216	277
104123000	72 38.06	150 26.00	.212	279
104130000	72 38.07	150 26.19	.212	279
104133000	72 38.08	150 26.38	.209	279
104140000	72 38.09	150 26.56	.202	279
104143000	72 38.10	150 26.74	.198	280
104150000	72 38.11	150 26.91	.202	281

Time (UTC) dddhhmmss	N.Latitude dd mm.mm	W.Longitude ddd mm.mm	spd km/hr	dir deg
104153000	72 38.12	150 27.10	.205	281
104160000	72 38.13	150 27.29	.216	280
104163000	72 38.14	150 27.49	.223	279
104170000	72 38.14	150 27.69	.227	277
104173000	72 38.15	150 27.90	.230	275
104180000	72 38.15	150 28.11	.230	271
104183000	72 38.14	150 28.32	.234	264
104190000	72 38.13	150 28.53	.238	257
104193000	72 38.11	150 28.72	.220	255
104200000	72 38.11	150 28.90	.202	264
104203000	72 38.11	150 29.11	.223	277
104210000	72 38.13	150 29.36	.292	280
104213000	72 38.14	150 29.68	.349	277
104220000	72 38.15	150 30.01	.371	274
104223000	72 38.15	150 30.33	.353	272
104230000	72 38.15	150 30.63	.331	272
104233000	72 38.16	150 30.92	.320	272
105000000	72 38.16	150 31.20	.310	273
105003000	72 38.17	150 31.47	.302	274
105010000	72 38.17	150 31.74	.295	276
105013000	72 38.19	150 32.01	.295	278
105020000	72 38.20	150 32.27	.295	280
105023000	72 38.21	150 32.53	.295	280
105030000	72 38.23	150 32.78	.281	279
105033000	72 38.24	150 33.01	.259	279
105040000	72 38.25	150 33.22	.238	280
105043000	72 38.26	150 33.42	.220	280
105050000	72 38.27	150 33.61	.212	279
105053000	72 38.27	150 33.79	.205	278
105060000	72 38.28	150 33.97	.202	277
105063000	72 38.29	150 34.15	.194	274
105070000	72 38.29	150 34.31	.184	271
105073000	72 38.28	150 34.47	.176	266
105080000	72 38.28	150 34.62	.166	263
105083000	72 38.27	150 34.77	.158	263
105090000	72 38.27	150 34.91	.155	265
105093000	72 38.27	150 35.05	.151	268
105100000	72 38.26	150 35.18	.151	268
105103000	72 38.26	150 35.31	.148	265
105110000	72 38.26	150 35.44	.137	263
105113000	72 38.25	150 35.54	.119	264
105120000	72 38.25	150 35.63	.097	268
105123000	72 38.25	150 35.70	.083	271
105130000	72 38.25	150 35.78	.079	271
105133000	72 38.26	150 35.86	.090	272
105140000	72 38.26	150 35.96	.112	275
105143000	72 38.26	150 36.08	.133	278
105150000	72 38.27	150 36.21	.140	279
105153000	72 38.27	150 36.32	.130	279
105160000	72 38.28	150 36.43	.122	275
105163000	72 38.28	150 36.54	.119	270
105170000	72 38.28	150 36.65	.119	269
105173000	72 38.28	150 36.75	.112	273
105180000	72 38.28	150 36.84	.104	279
105183000	72 38.29	150 36.93	.101	283
105190000	72 38.30	150 37.03	.104	283
105193000	72 38.30	150 37.13	.115	285
105200000	72 38.31	150 37.24	.126	286
105203000	72 38.32	150 37.35	.126	287
105210000	72 38.33	150 37.46	.126	284
105213000	72 38.34	150 37.57	.126	279
105220000	72 38.34	150 37.68	.126	277
105223000	72 38.35	150 37.79	.119	279
105230000	72 38.35	150 37.88	.101	282
105233000	72 38.36	150 37.94	.072	286
106000000	72 38.36	150 37.96	.025	288

APPENDIX B

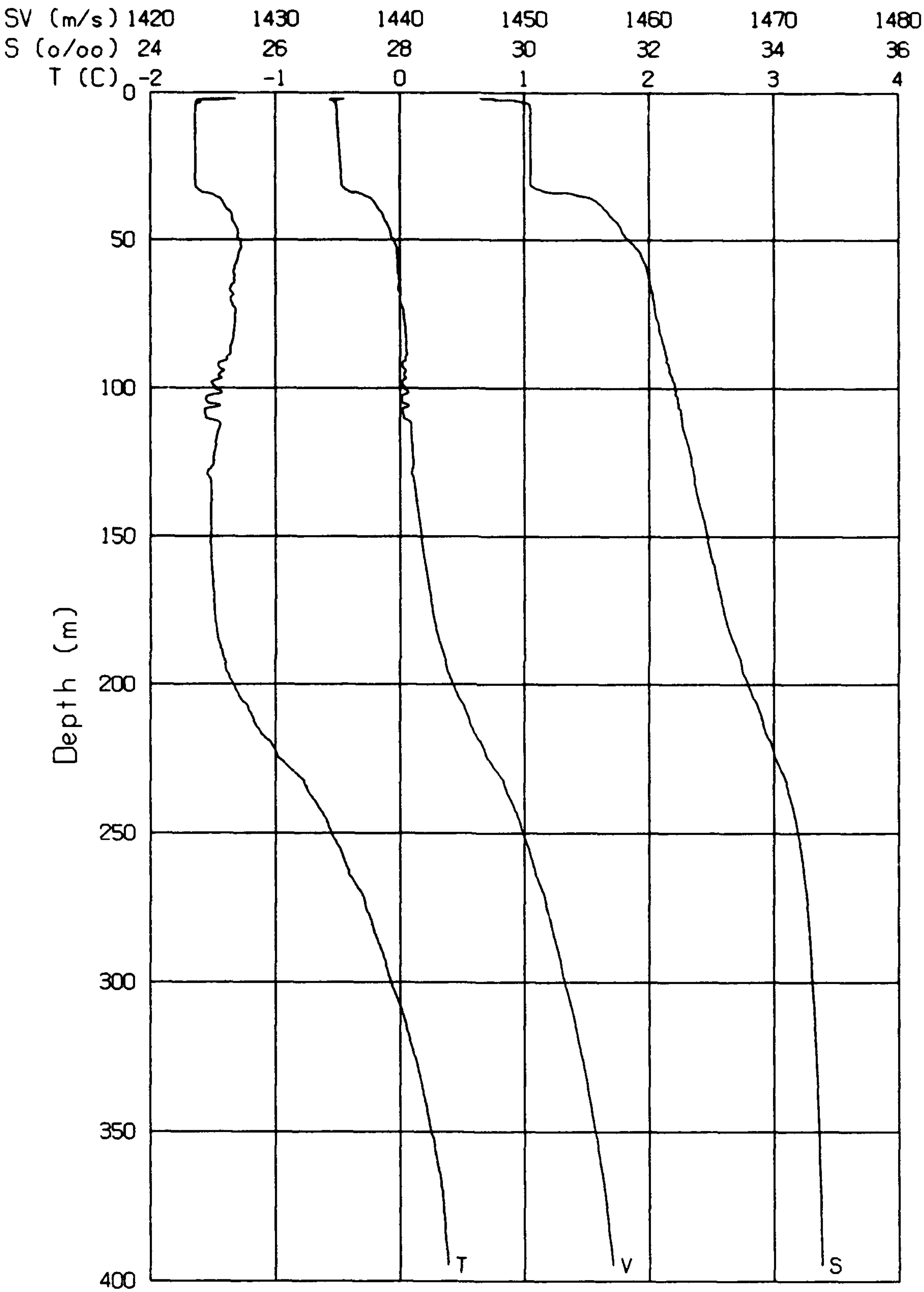
STD Plots

Date	Time (Local)	Cast No.	Latitude	Longitude
03-29-93	1851	CAST 001	72°34.8′N	147°23.3′W
03-30-93	0649	CAST 002	72°34.5′N	147°24.2′W
03-30-93	1738	CAST 003	72°34.0′N	147°29.5′W
03-31-93	0632	CAST 004	72°34.0′N	147°39.1′W
03-31-93	2016	CAST 005	72°34.6′N	147°51.3′W
04-01-93	1613	CAST 006	72°35.9′N	148°11.2′W
04-02-93	0630	CAST 007	73°36.0′N	148°24.8′W
04-02-93	1520	CAST 008	72°35.6′N	148°32.5′W
04-02-93	1847	CAST 009	72°35.4′N	148°36.1′W
04-02-93	2229	CAST 010	72°35.2′N	148°38.9′W
04-03-93	0630	CAST 011	72°34.9′N	148°44.6′W
04-03-93	1406	CAST 012	72°34.7′N	148°52.5′W
04-03-93	2128	CAST 013	72°35.1′N	149°01.3′W
04-04-93	0610	CAST 014	72°35.6′N	149°08.5′W
04-04-93	1416	CAST 015	72°36.1′N	149°16.2′W
04-05-93	0848	CAST 016	72°36.7′N	149°28.5′W
04-05-93	1654	CAST 017	72°37.3′N	149°32.7′W
04-06-93	0934	CAST 018	72°38.1′N	149°40.7′W
04-06-93	1147	CAST 019	72°38.2′N	149°41.5′W
04-06-93	1617	CAST 020	72°38.5′N	149°44.2′W
04-06-93	2140	CAST 021	72°38.6′N	149°45.8′W
04-07-93	0751	CAST 022	72°38.5′N	149°47.5′W
04-07-93	2014	CAST 023	72°38.1′N	149°50.7′W
04-08-93	0914	CAST 024	72°37.8′N	149°51.9′W
04-08-93	1844	CAST 025	72°37.5′N	149°55.4′W
04-09-93	0831	CAST 026	72°37.3′N	149°56.5′W
04-09-93	1427	CAST 027	72°37.3′N	149°58.3′W
04-09-93	2239	CAST 028	72°36.9′N	150°02.5′W
04-10-93	1232	CAST 029	72°36.9′N	150°04.9′W
04-10-93	1750	CAST 030	72°36.9′N	150°07.3′W
04-11-93	0656	CAST 031	72°36.9′N	150°09.5′W
04-11-93	1424	CAST 032	72°36.9′N	150°10.5′W
04-11-93	2340	CAST 033	72°37.2′N	150°12.8′W
04-12-93	0746	CAST 034	72°37.4′N	150°13.8′W
04-12-93	1450	CAST 035	72°37.4′N	150°14.6′W
04-12-93	2248	CAST 036	72°37.5′N	150°16.1′W
04-13-93	0754	CAST 037	72°37.7′N	150°18.0′W
04-13-93	2320	CAST 038	72°38.0′N	150°24.0′W
04-14-93	0635	CAST 039	72°38.1′N	150°26.7′W
04-14-93	1418	CAST 040	72°38.1′N	150°30.2′W
04-14-93	2134	CAST 041	72°38.3′N	150°33.7′W
04-15-93	0621	CAST 042	72°38.8′N	150°36.1′W
04-15-93	1407	CAST 043	72°38.3′N	150°37.7′W



03-29-93 1851 CAST 001 72-34.76N/147-23.3W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

03-30-93 0649 CAST 002 72-34.5 N / 147-24.2 W



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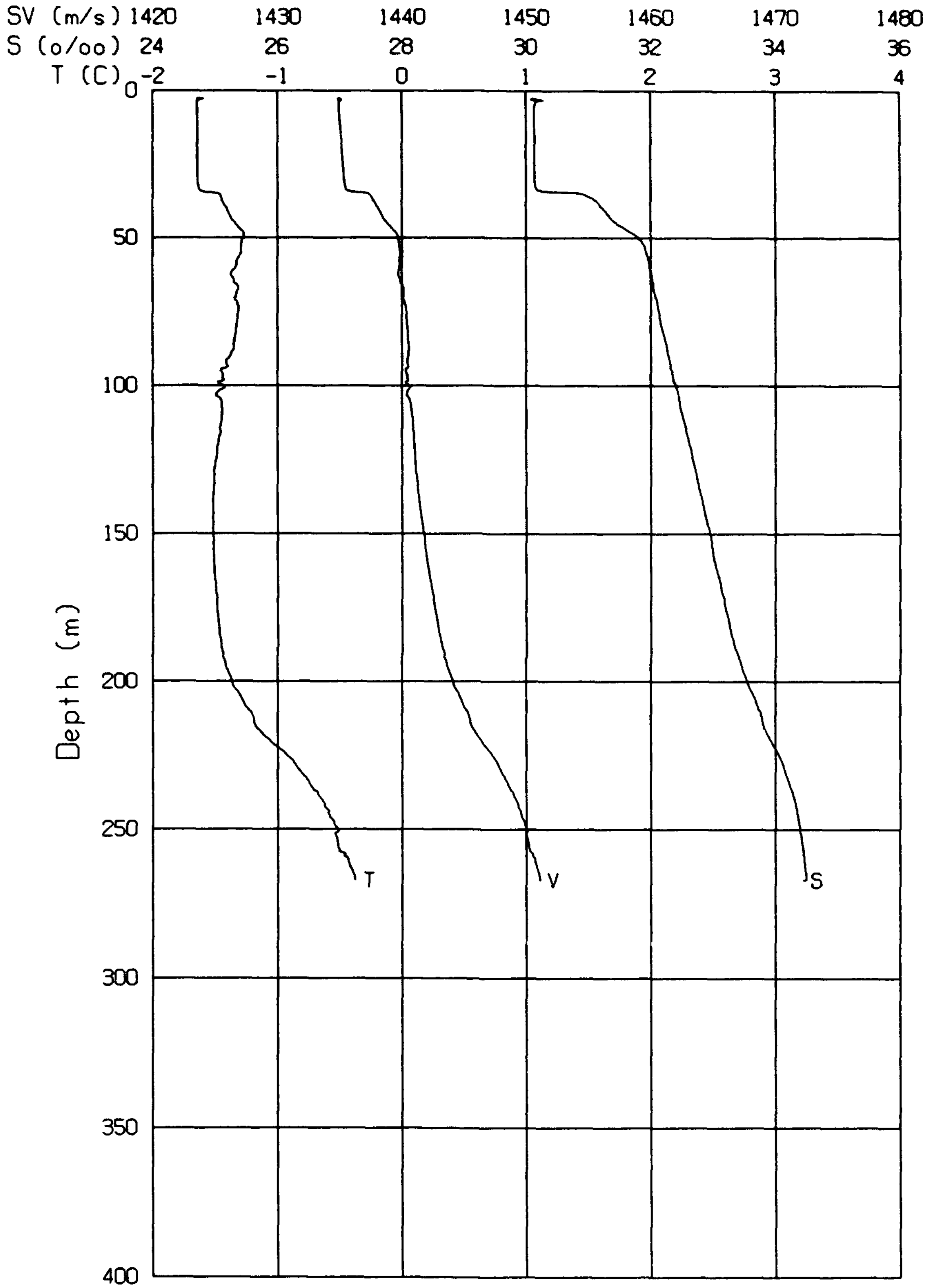
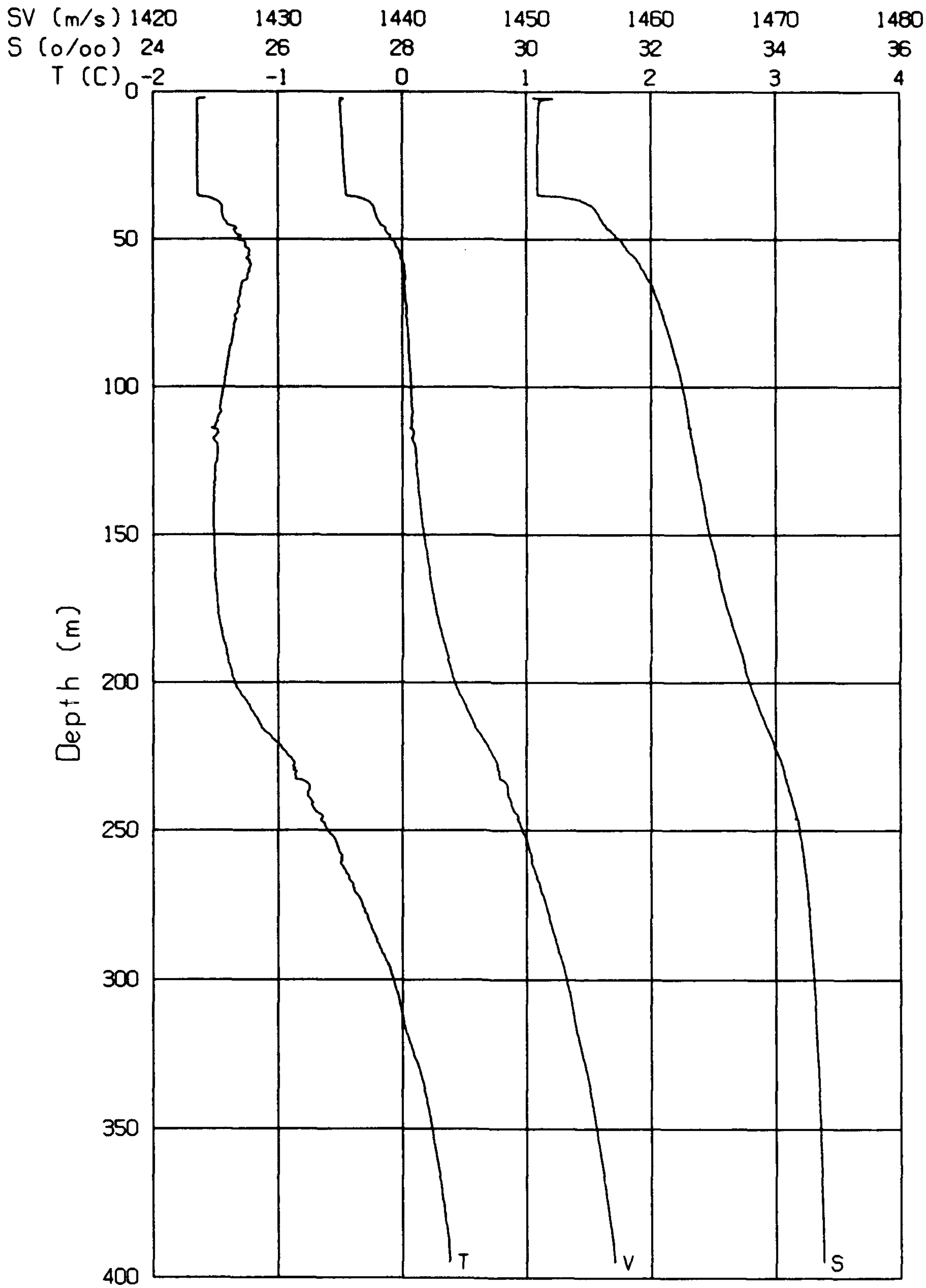
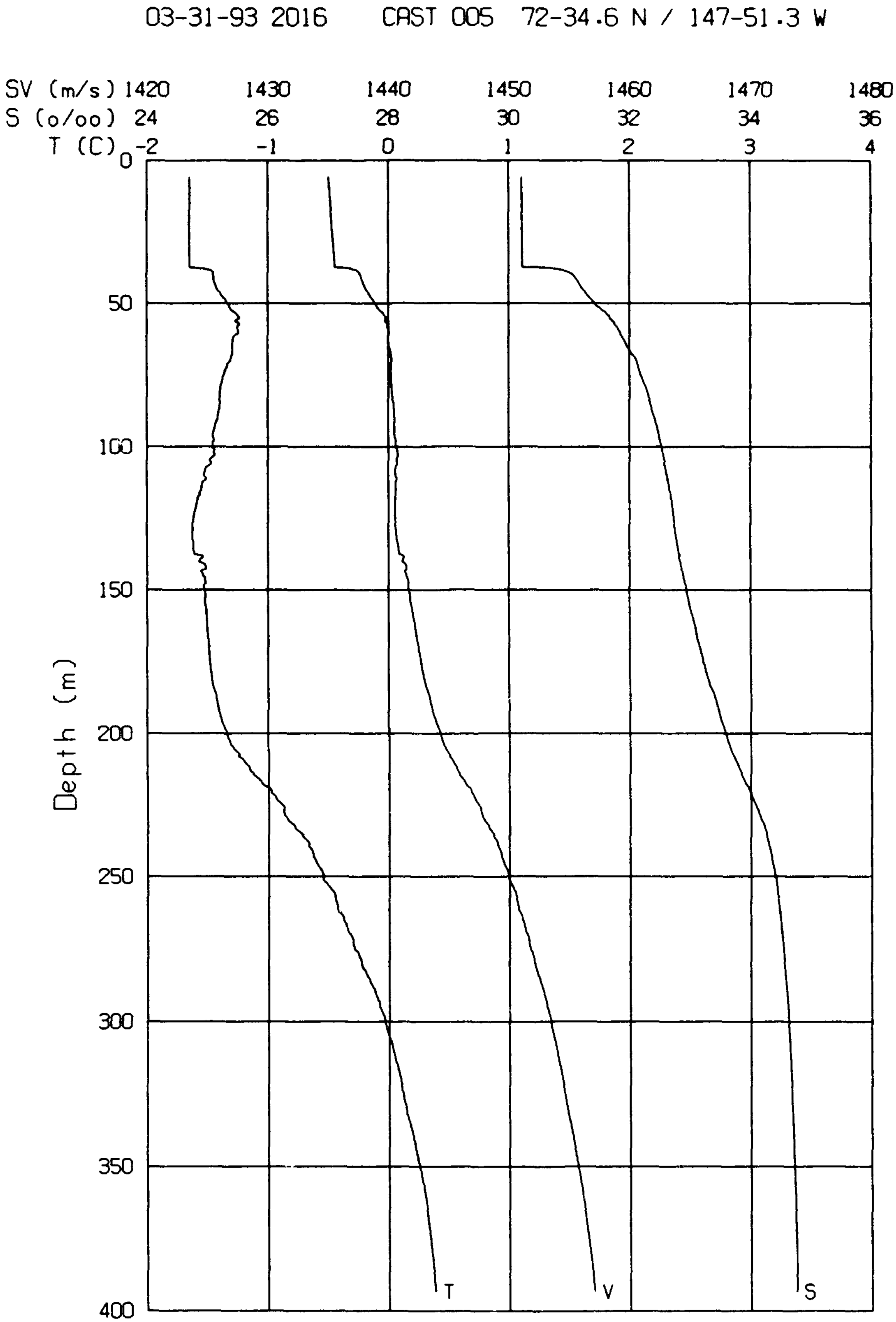


03-31-93 0632 CAST 004 72-34.0 N / 147-39.1 W




03-31-93 2016 CAST 005 72-34.6 N / 147-51.3 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
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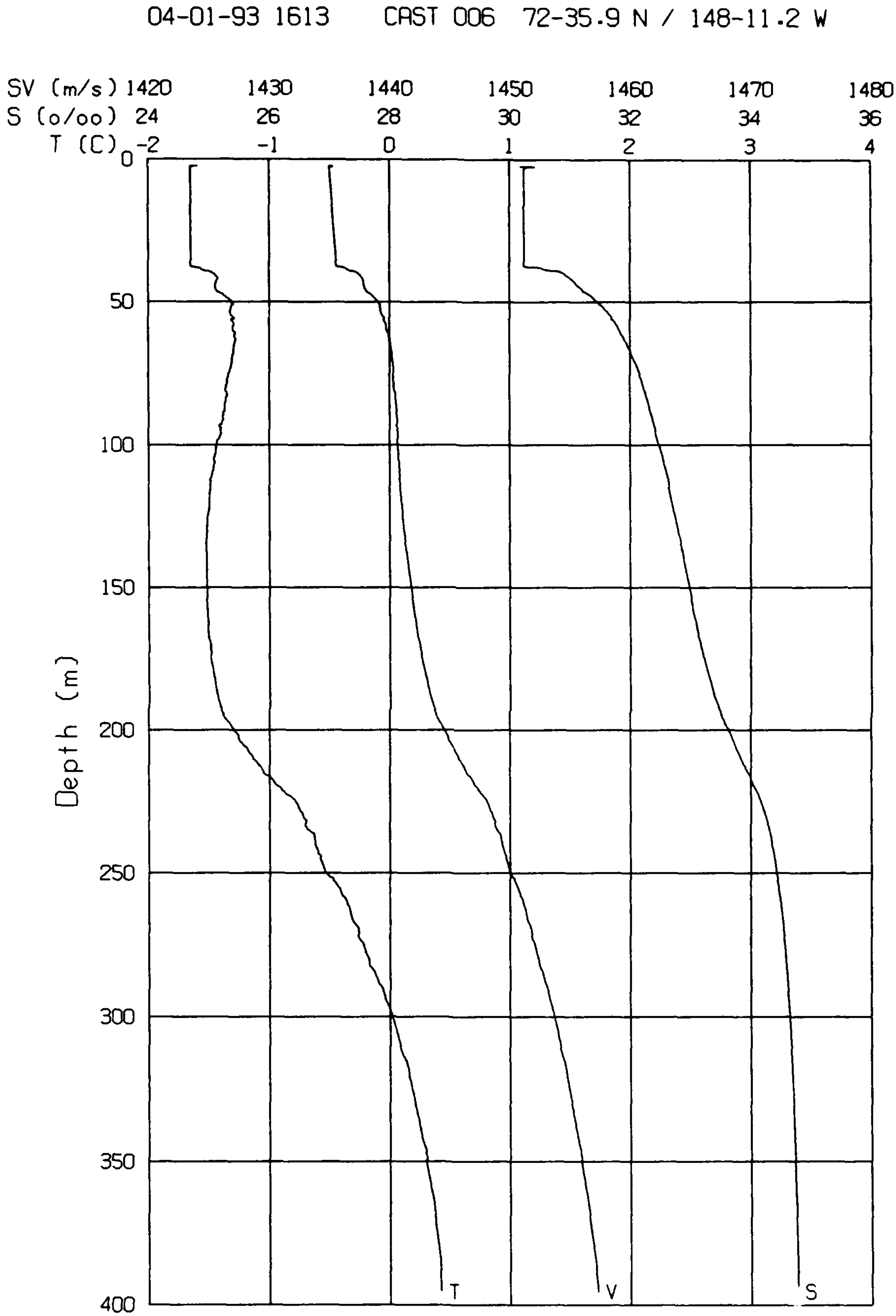
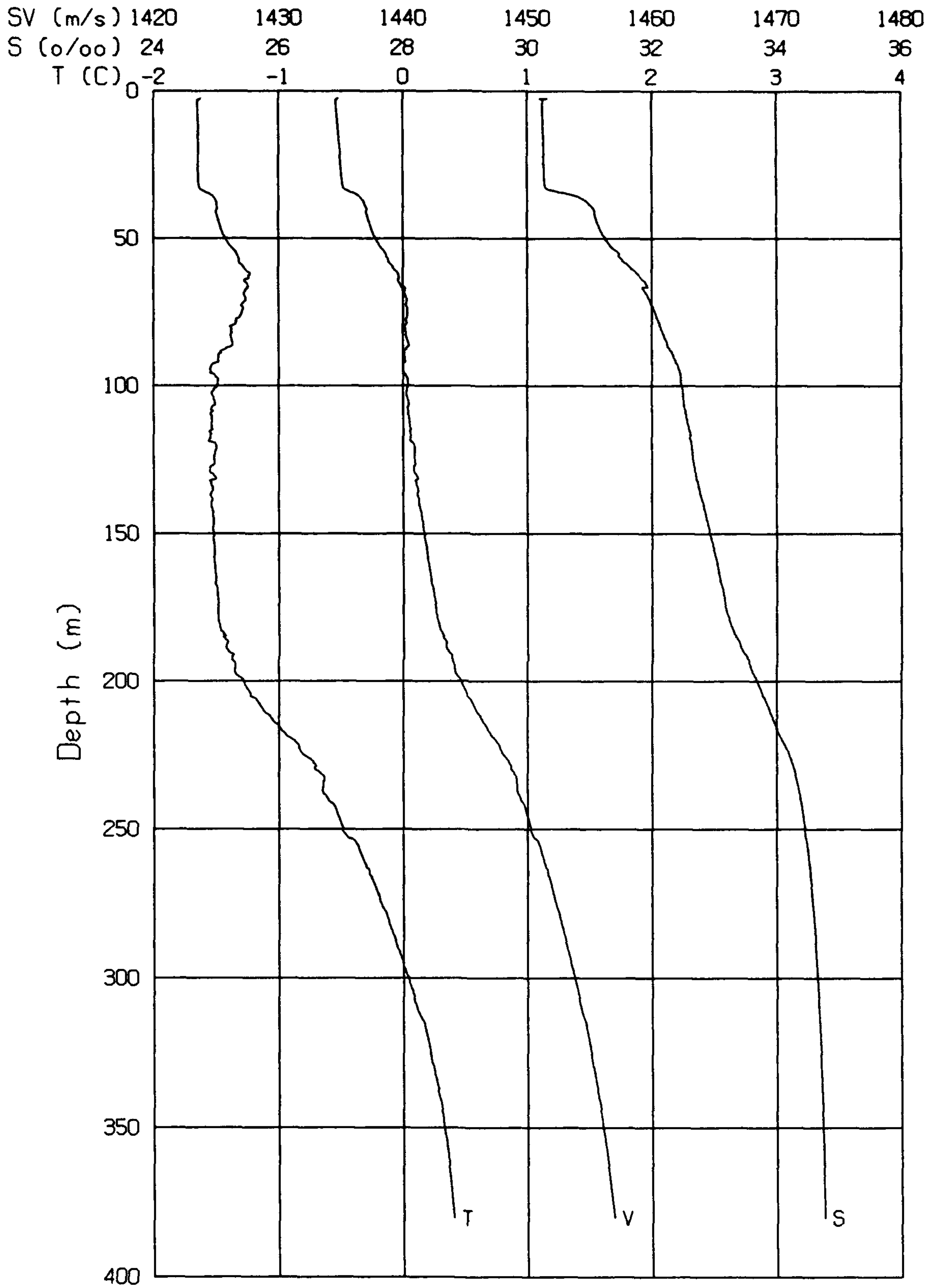
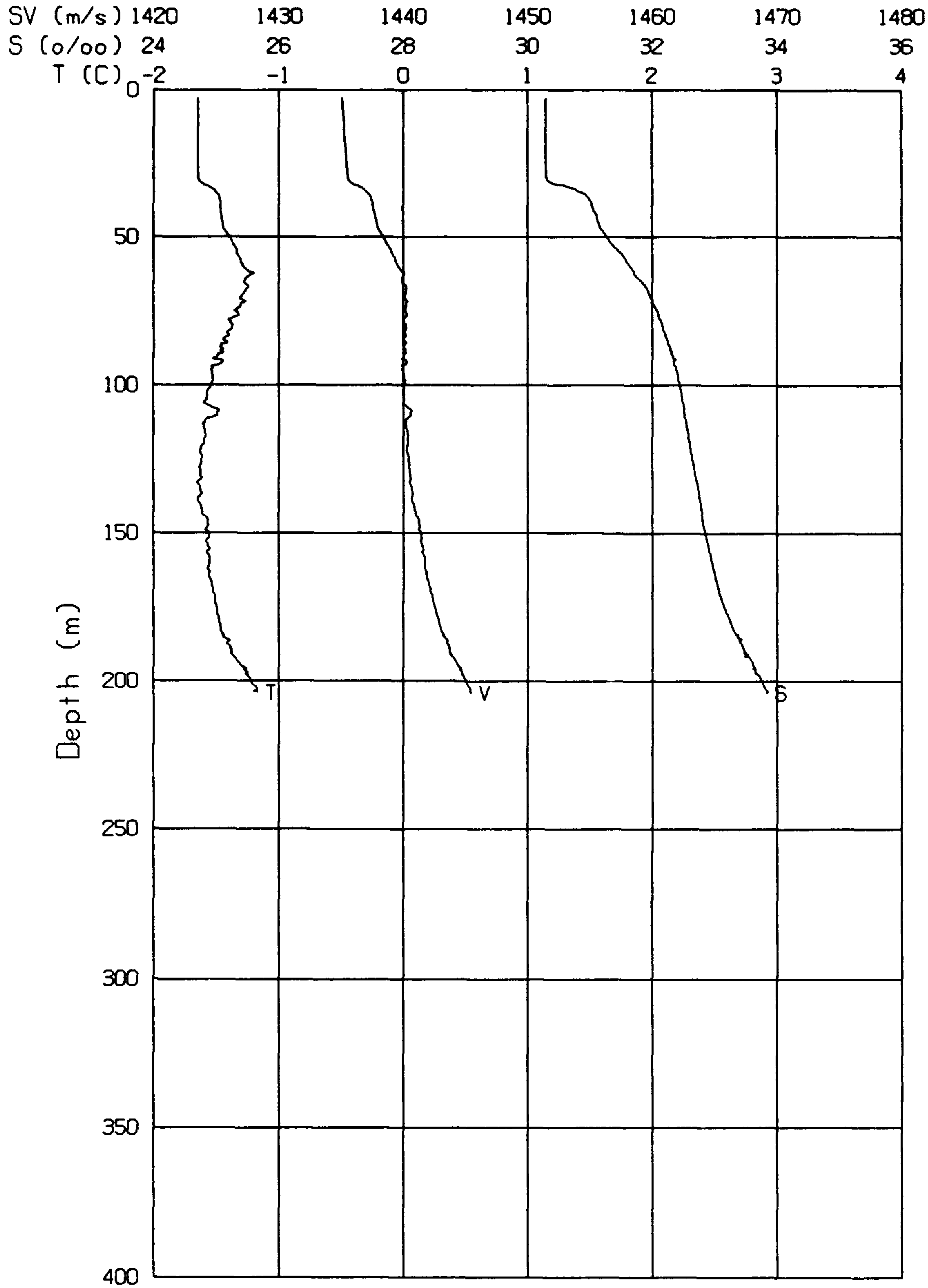
100
150
200
250
300
350
400
T
V
S


04-01-93 1613 CAST 006 72-35.9 N / 148-11.2 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

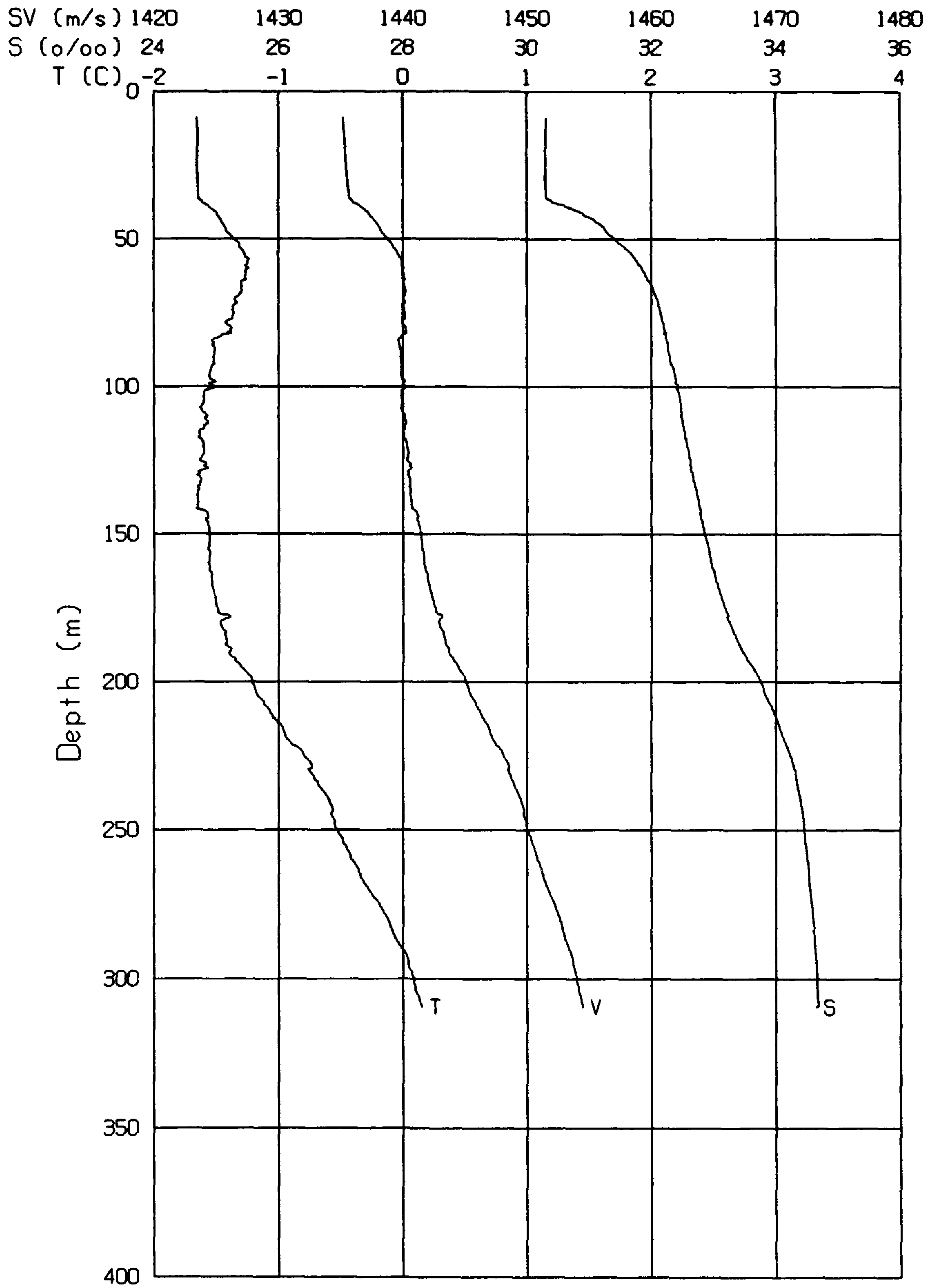
04-02-93 0630   CAST 007 73-36.0 N / 148-24.8 W

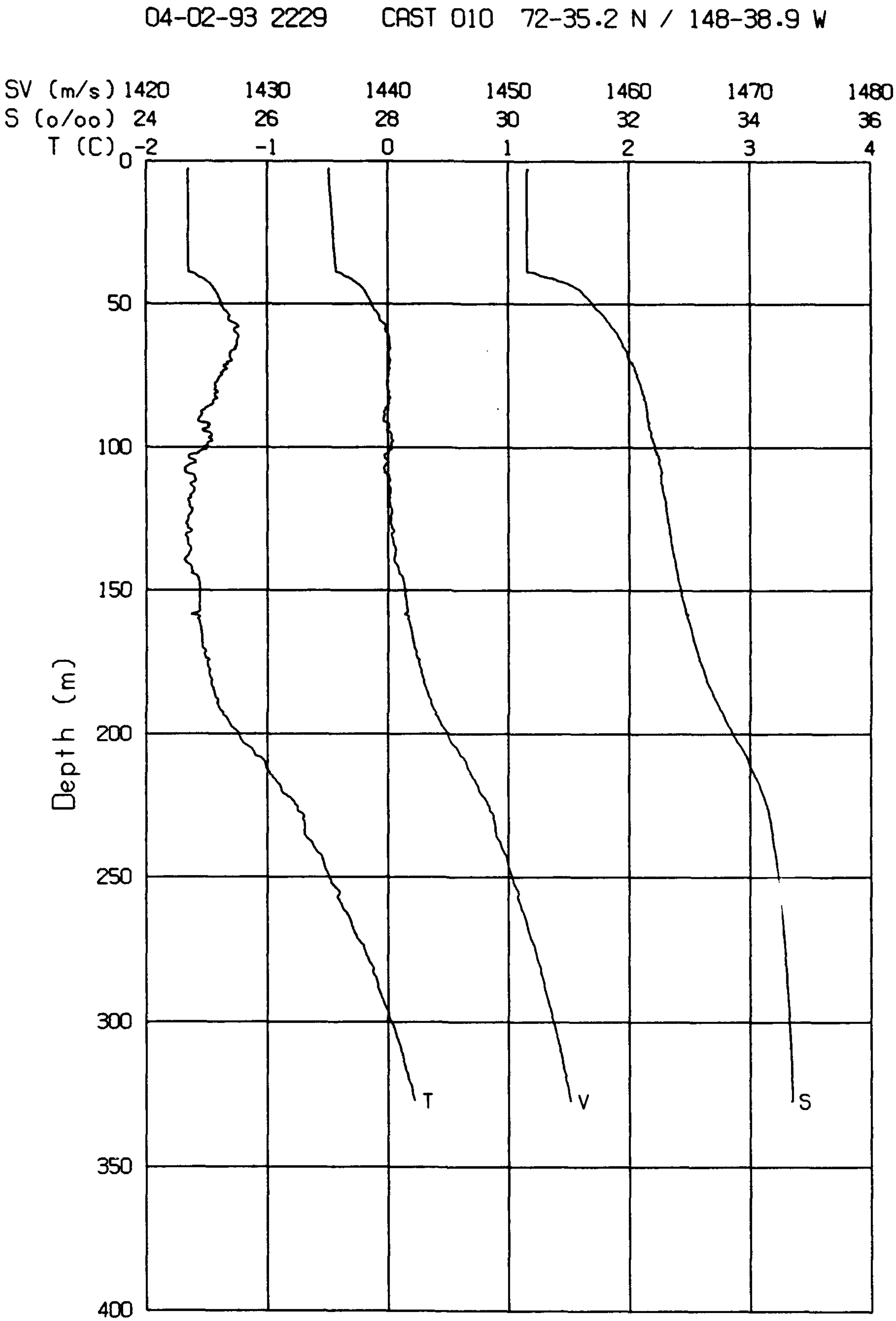


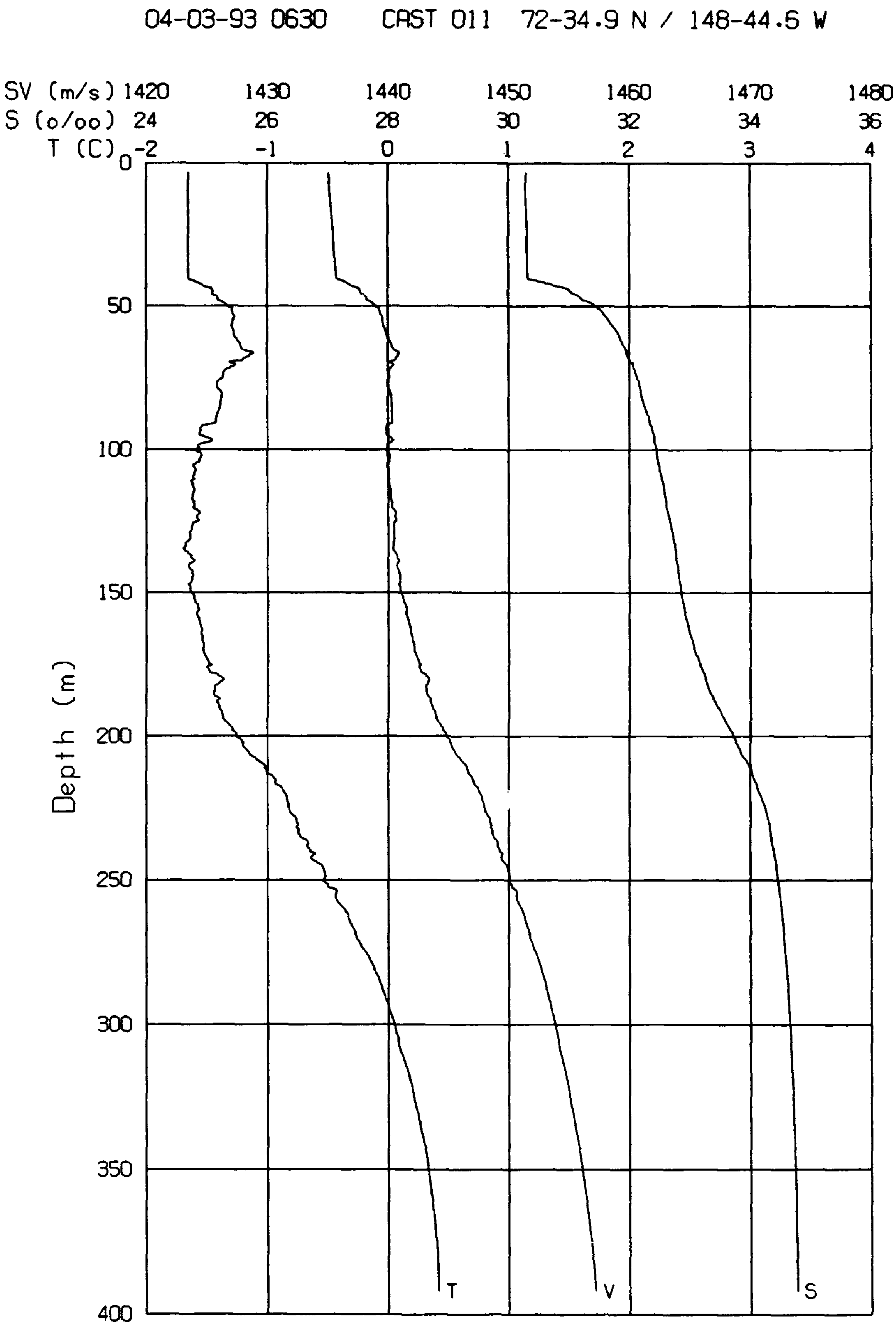
04-02-93 1520 CAST 008 72-35.6 N / 148-32.5 W



04-02-93 1847 CAST 009 72-35.4 N / 148-36.1 W

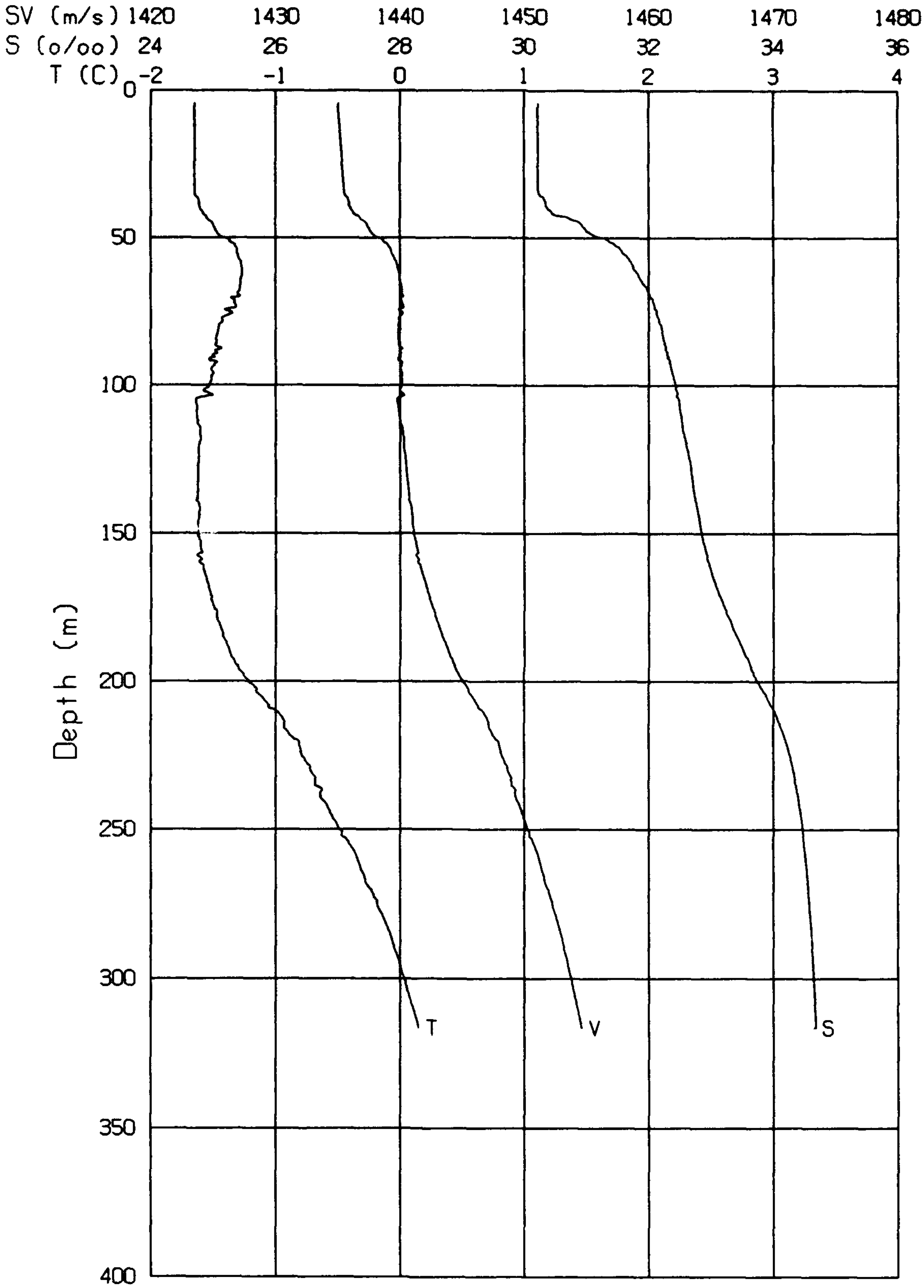


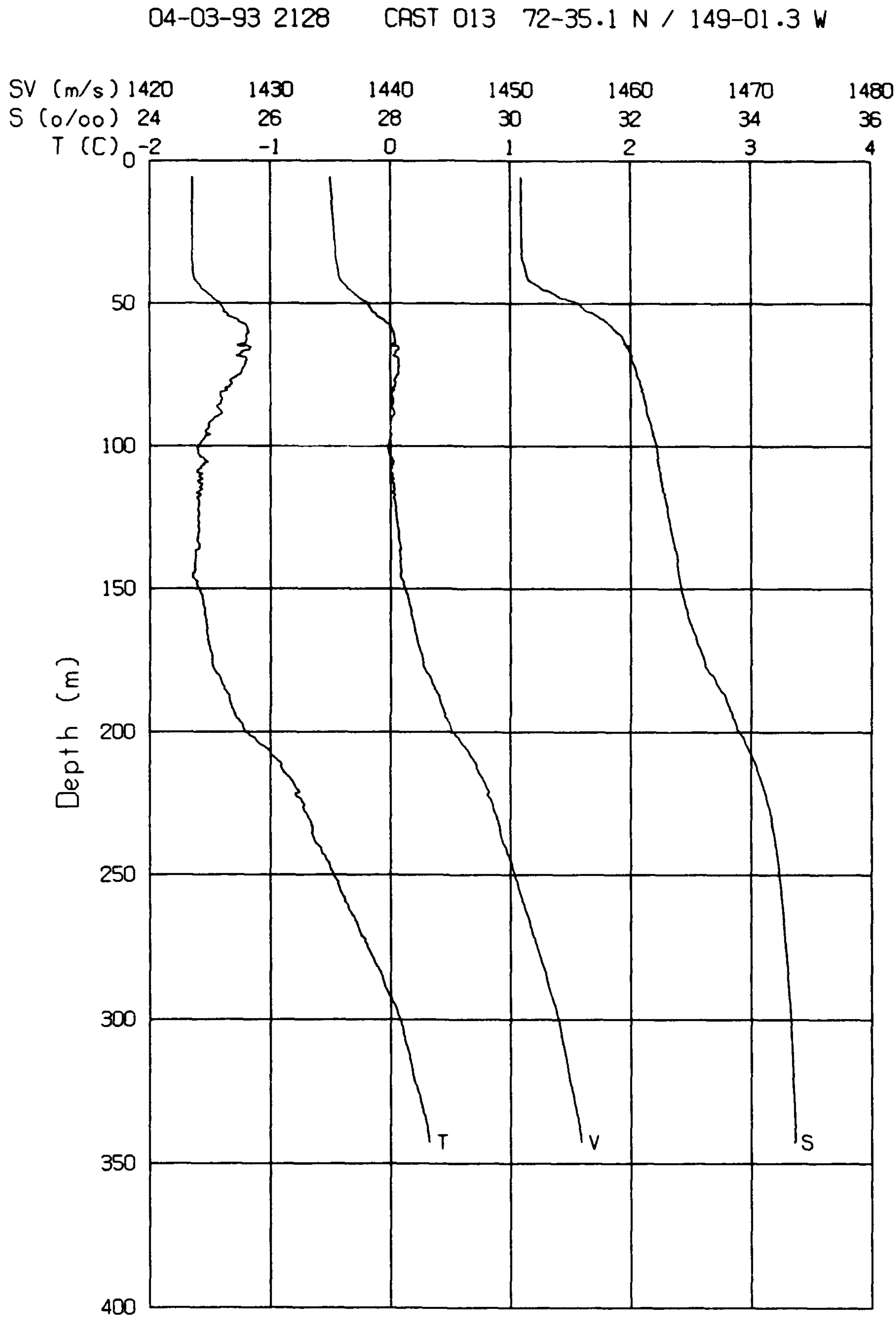

04-02-93 2229 CAST 010 72-35.2 N / 148-38.9 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

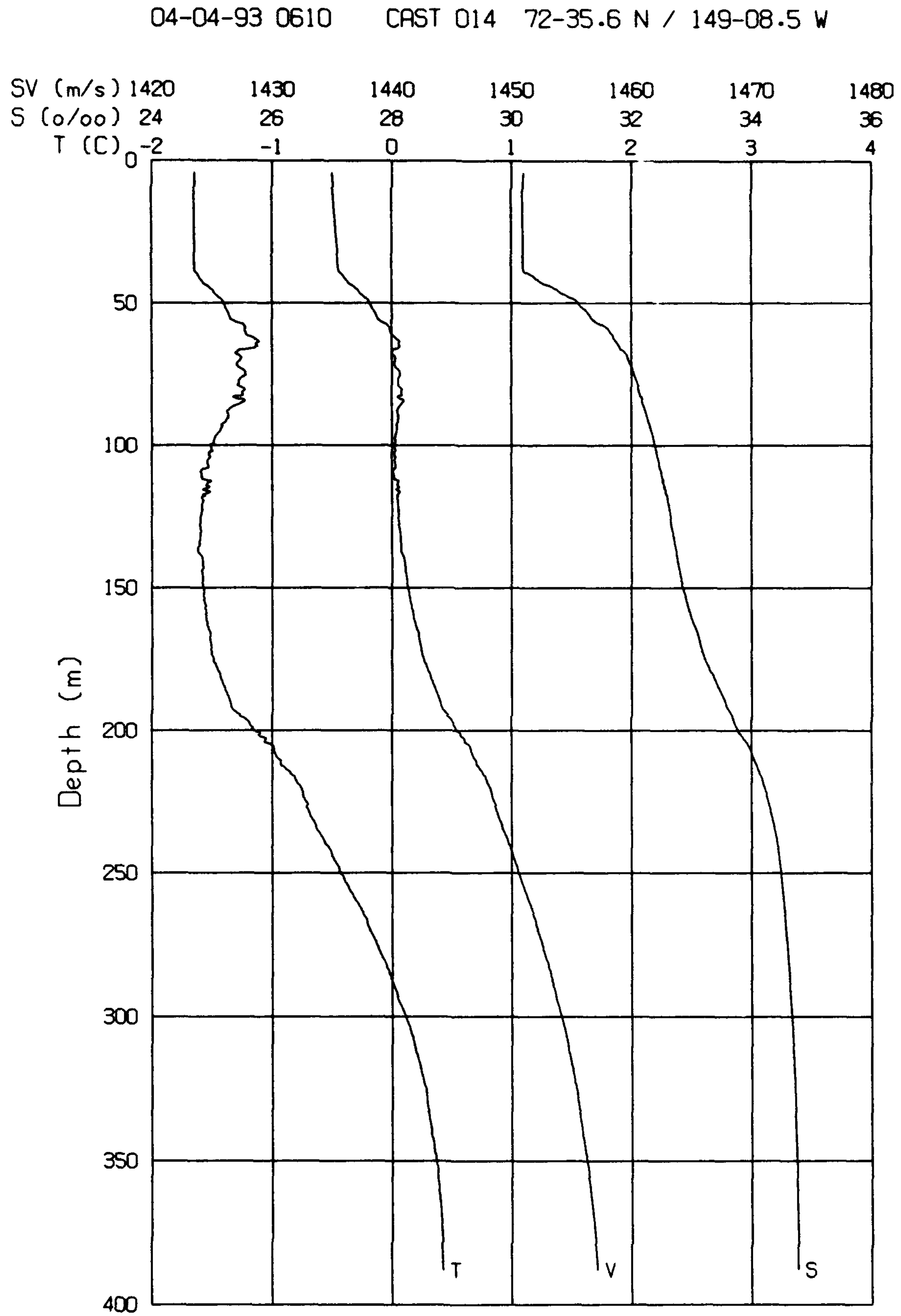


04-03-93 0630 CAST 011 72-34.9 N / 148-44.6 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
0
50
100
150
200
250
300
350
400
Depth (m)
T
V
S

04-03-93 1406   CAST 012 72-34.7 N / 148-52.5 W




04-03-93 2128 CAST 013 72-35.1 N / 149-01.3 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S



04-04-93 0610 CAST 014 72-35.6 N / 149-08.5 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
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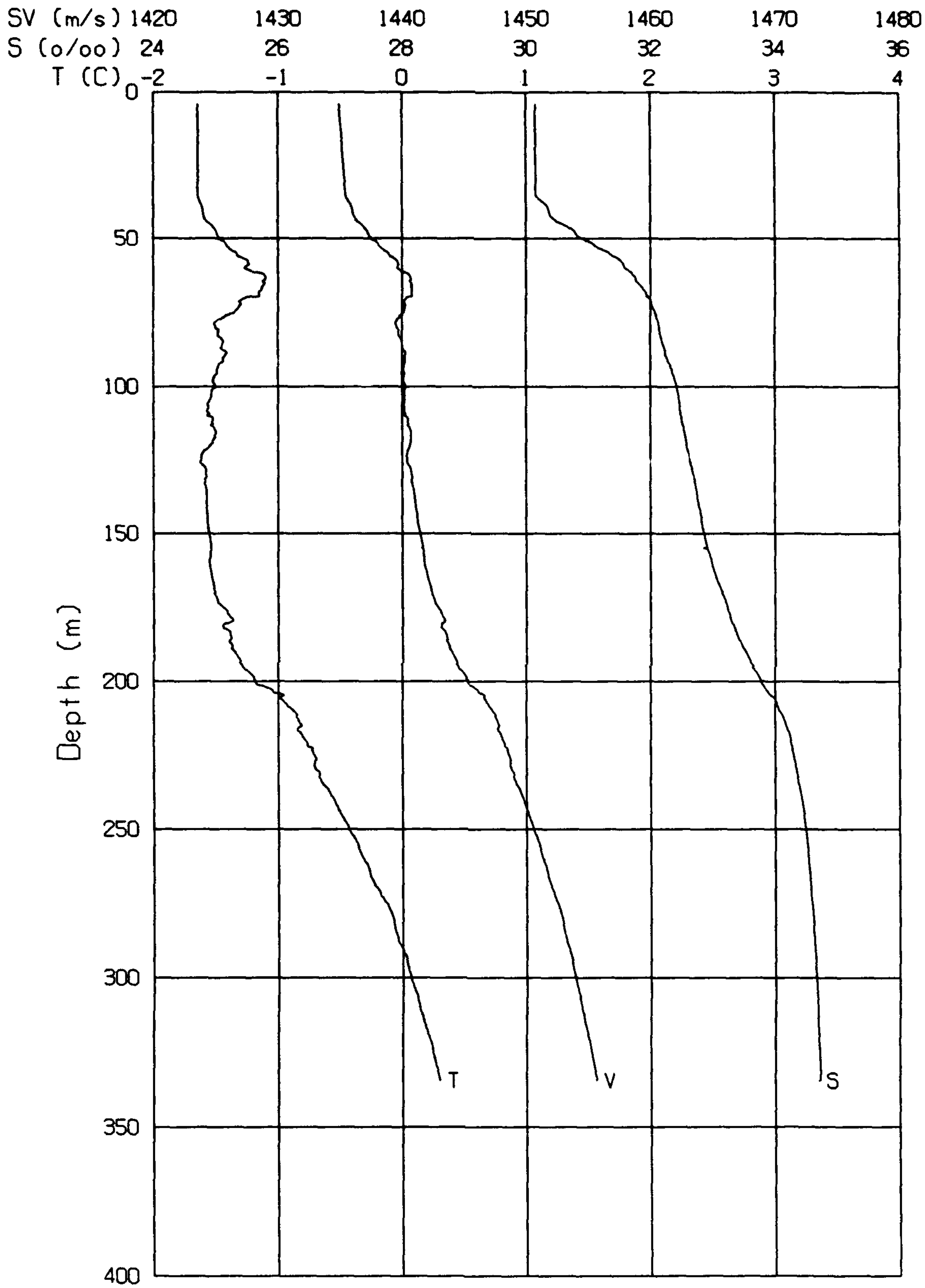
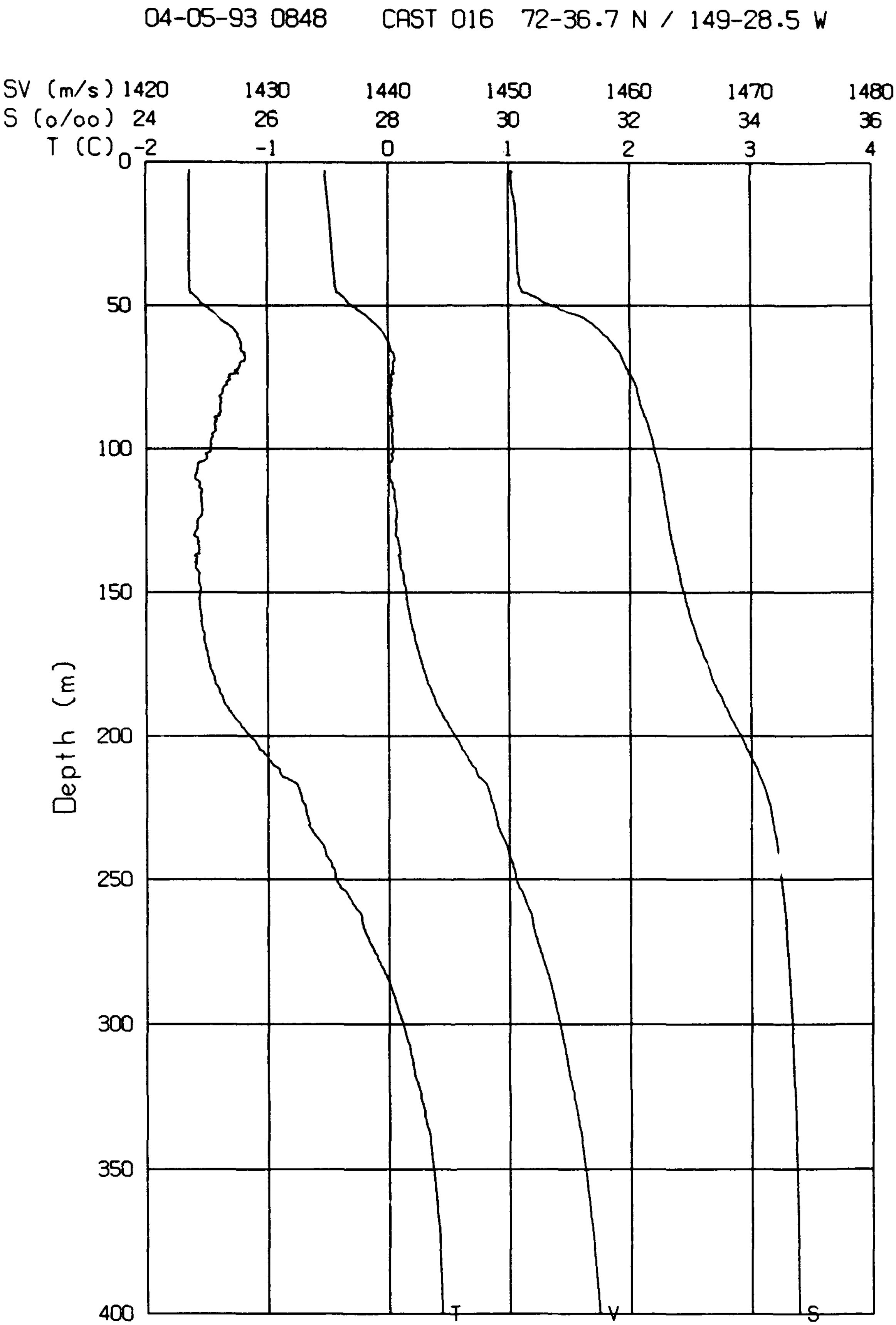
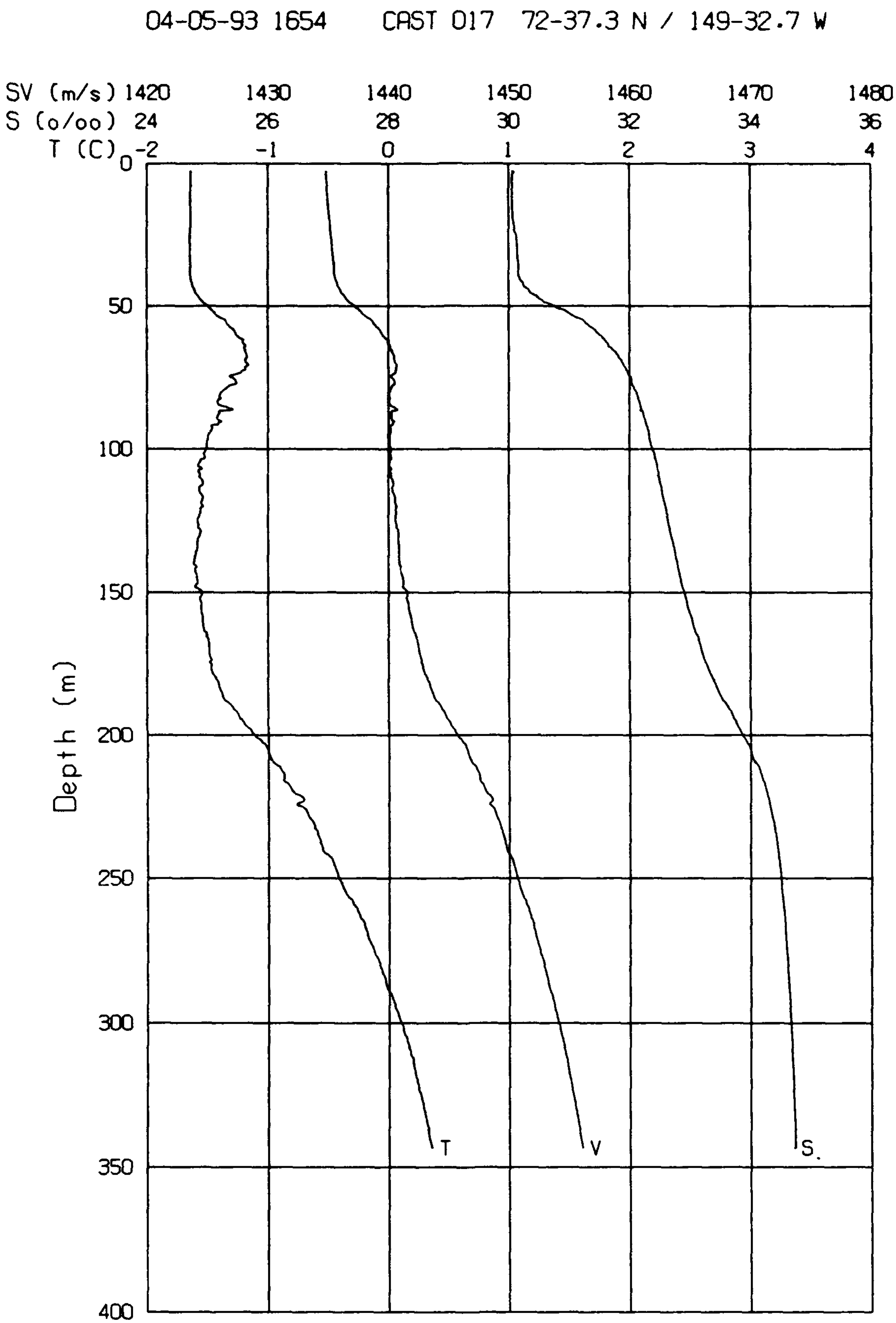
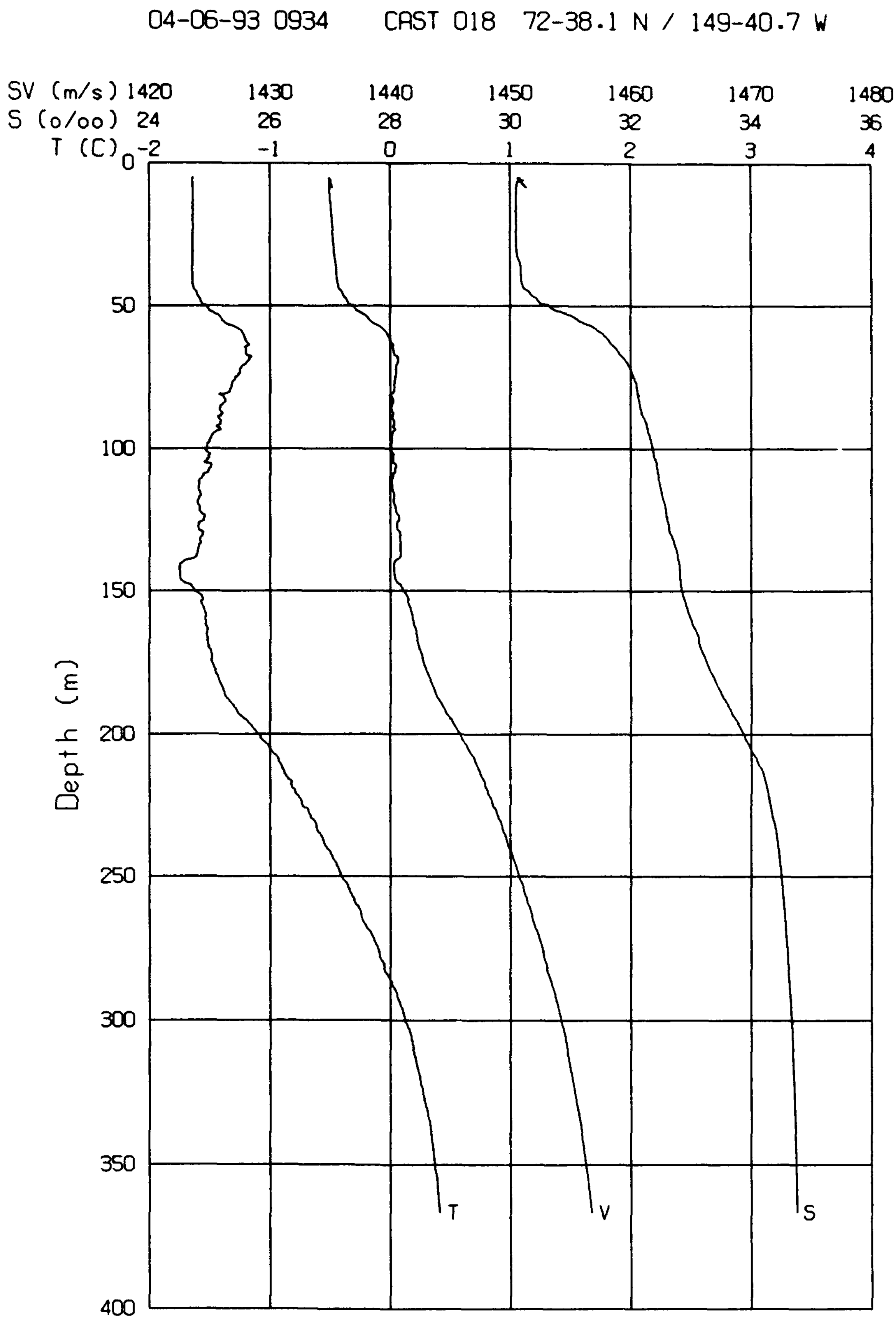
100
150
200
250
300
350
400
T
V
S

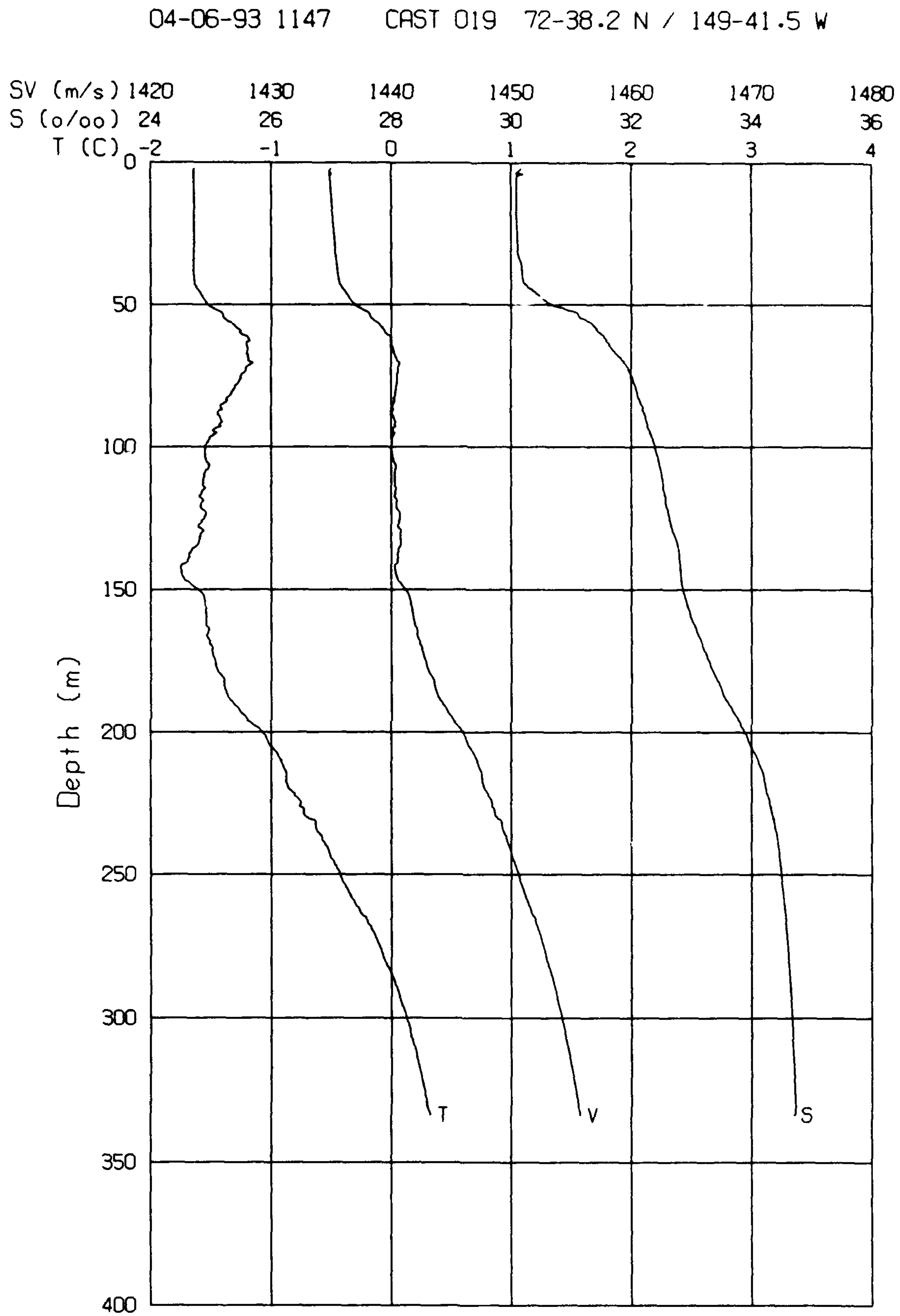
04-04-93 1416 CAST 015 72-36.1 N / 149-16.2 W




04-05-93 0848 CAST 016 72-36.7 N / 149-28.5 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

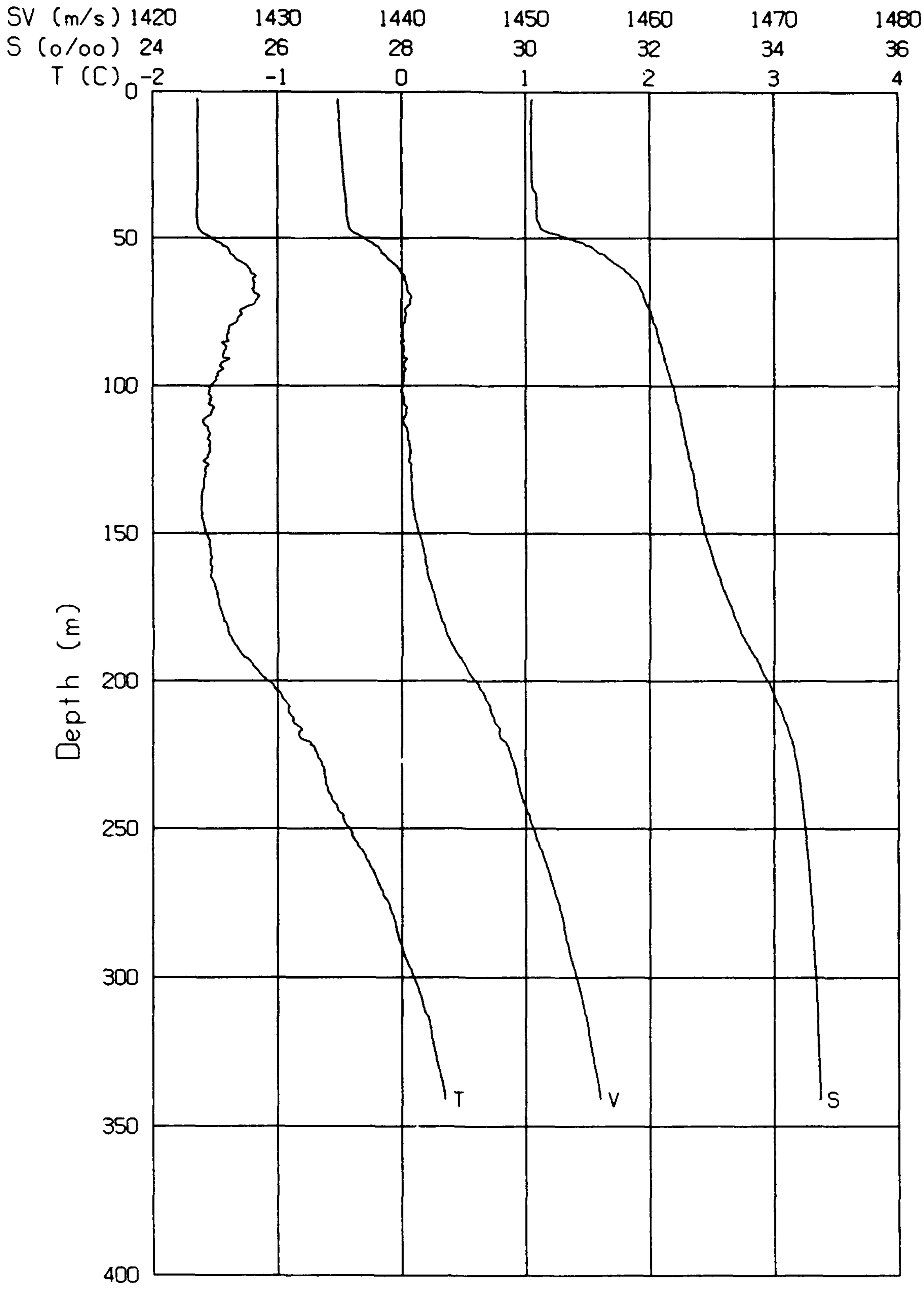

04-05-93 1654 CAST 017 72-37.3 N / 149-32.7 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S


04-06-93 0934 CAST 018 72-38.1 N / 149-40.7 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

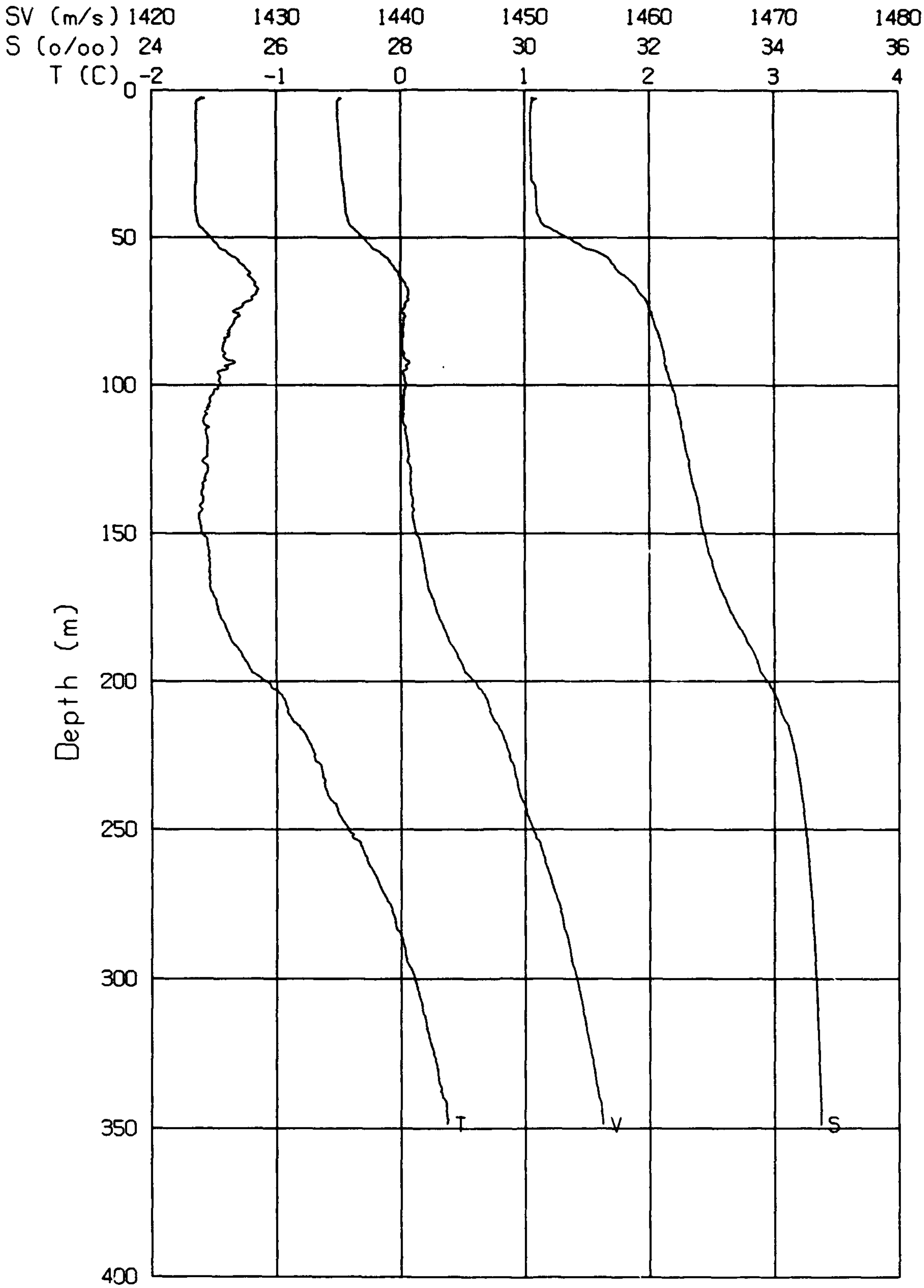


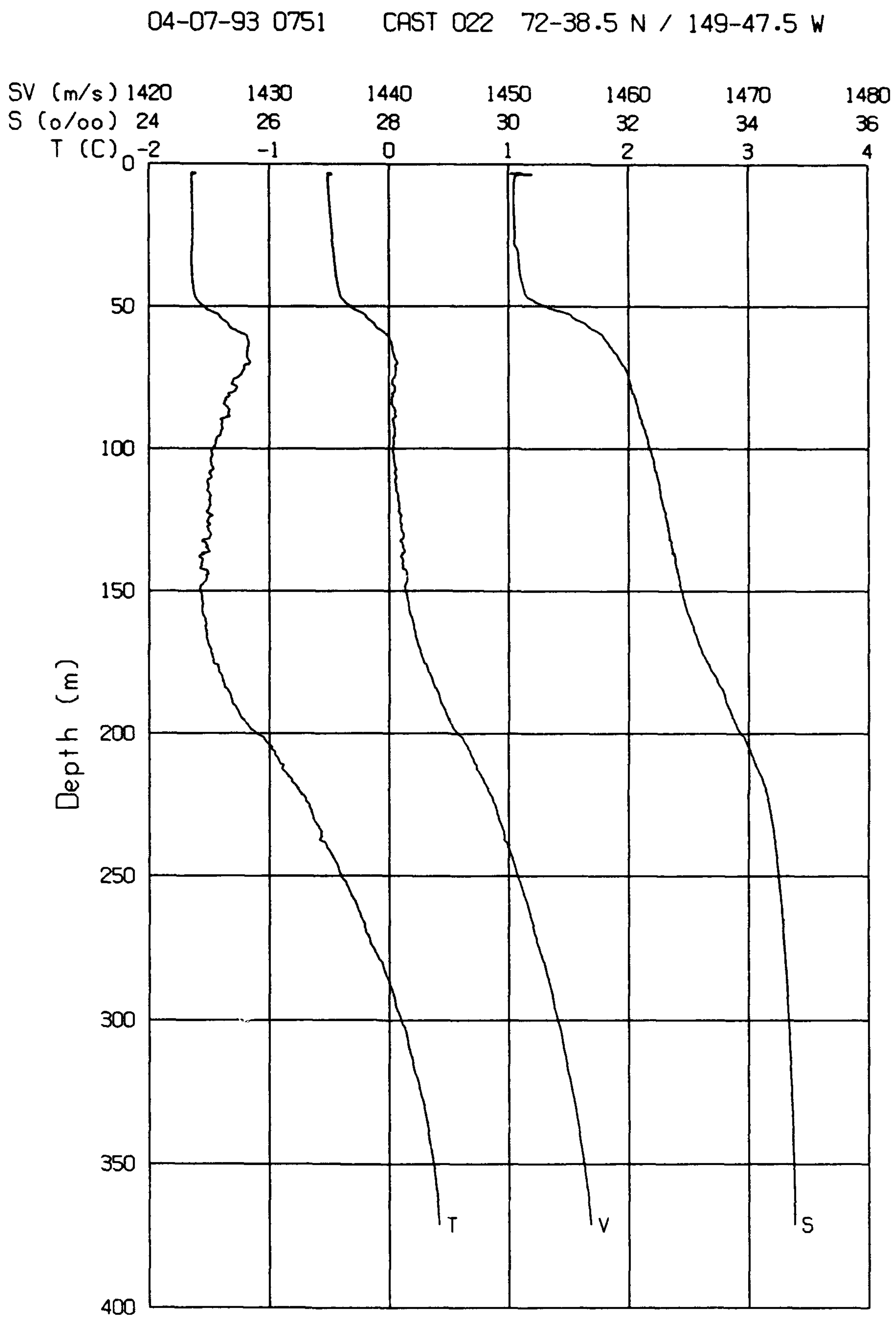
04-06-93 1147 CAST 019 72-38.2 N / 149-41.5 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

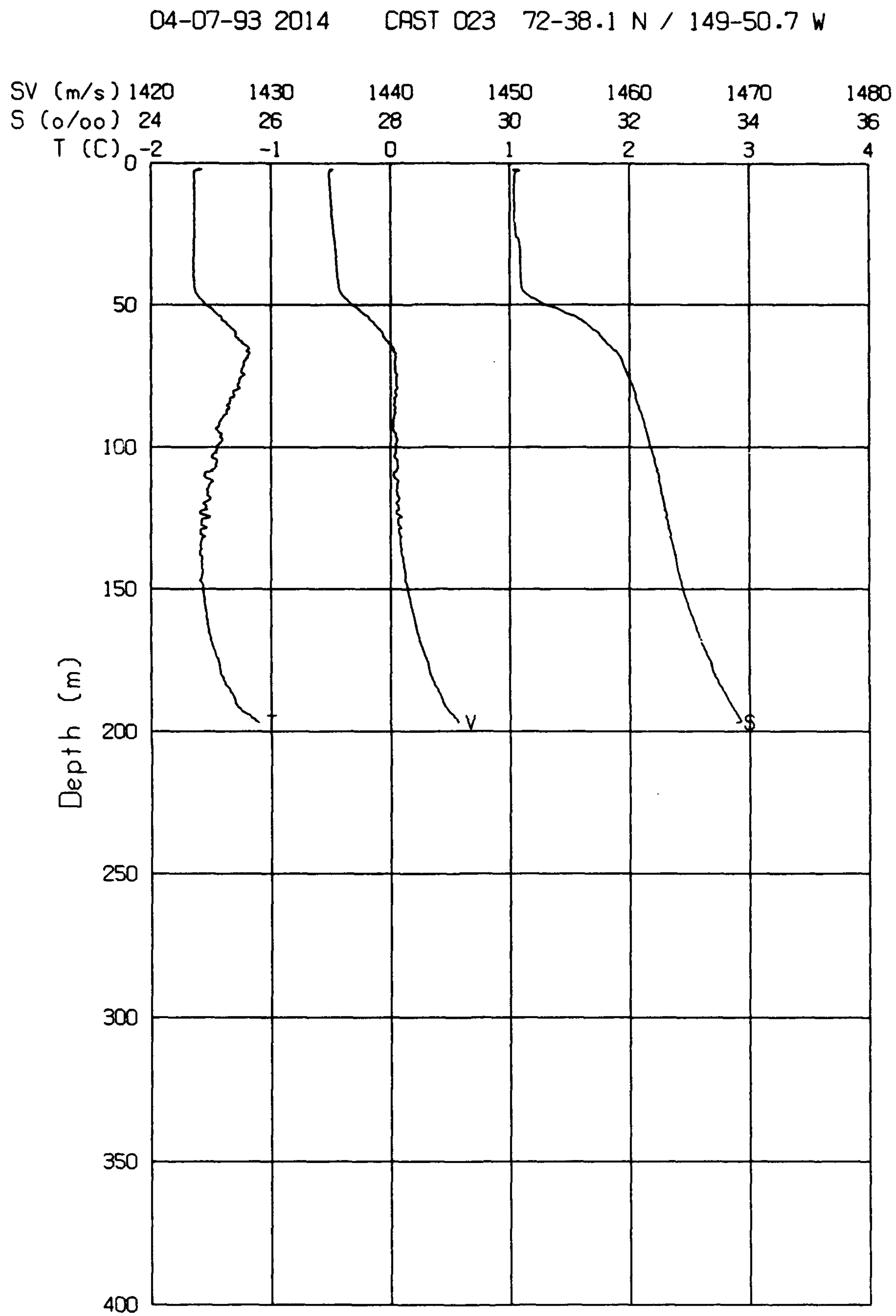
04-06-93 1617 CAST 020 72-38.5 N / 149-44.2 W



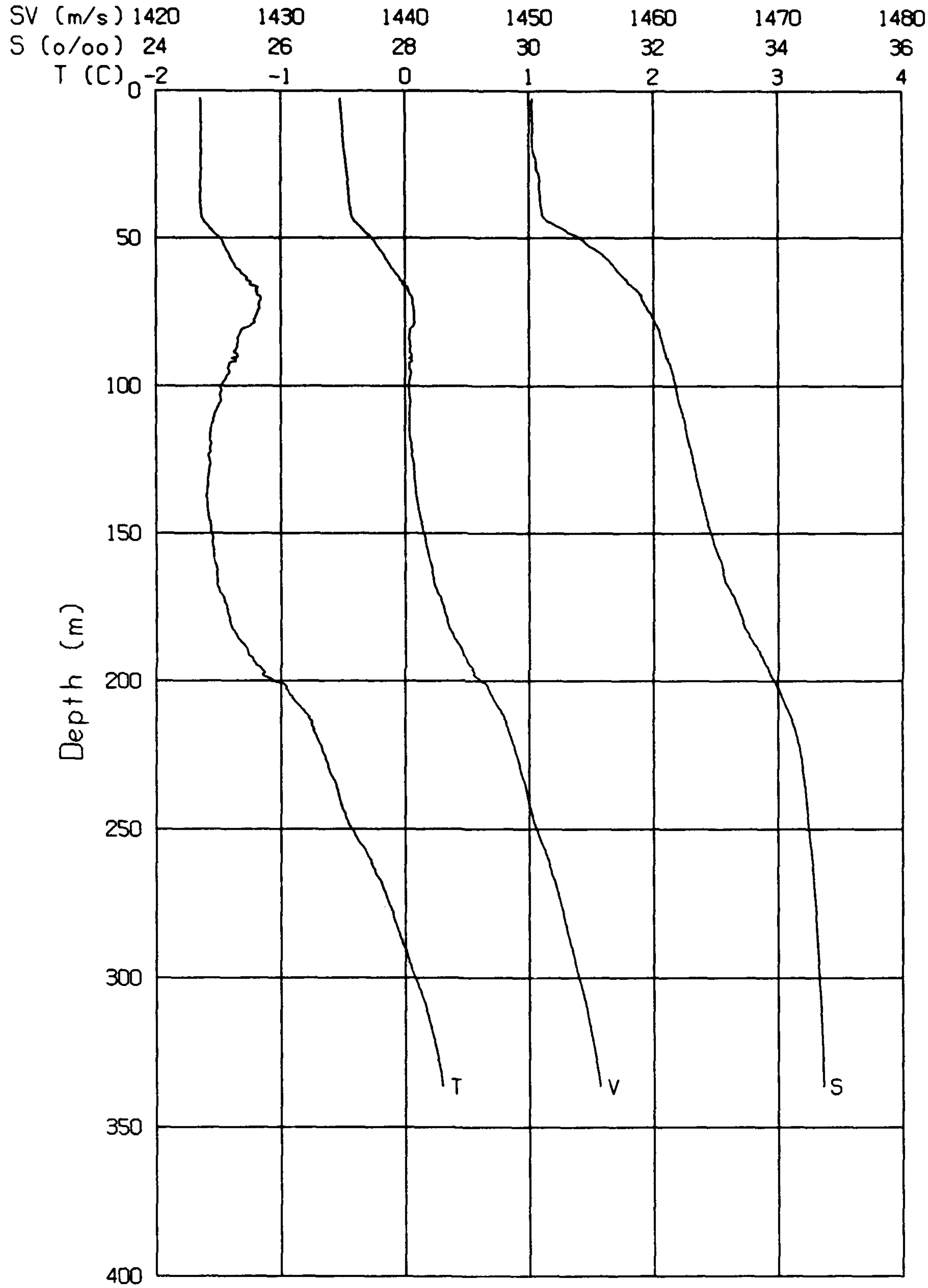
04-06-93 2140 CAST 021 72-38.6 N / 149-45.8 W



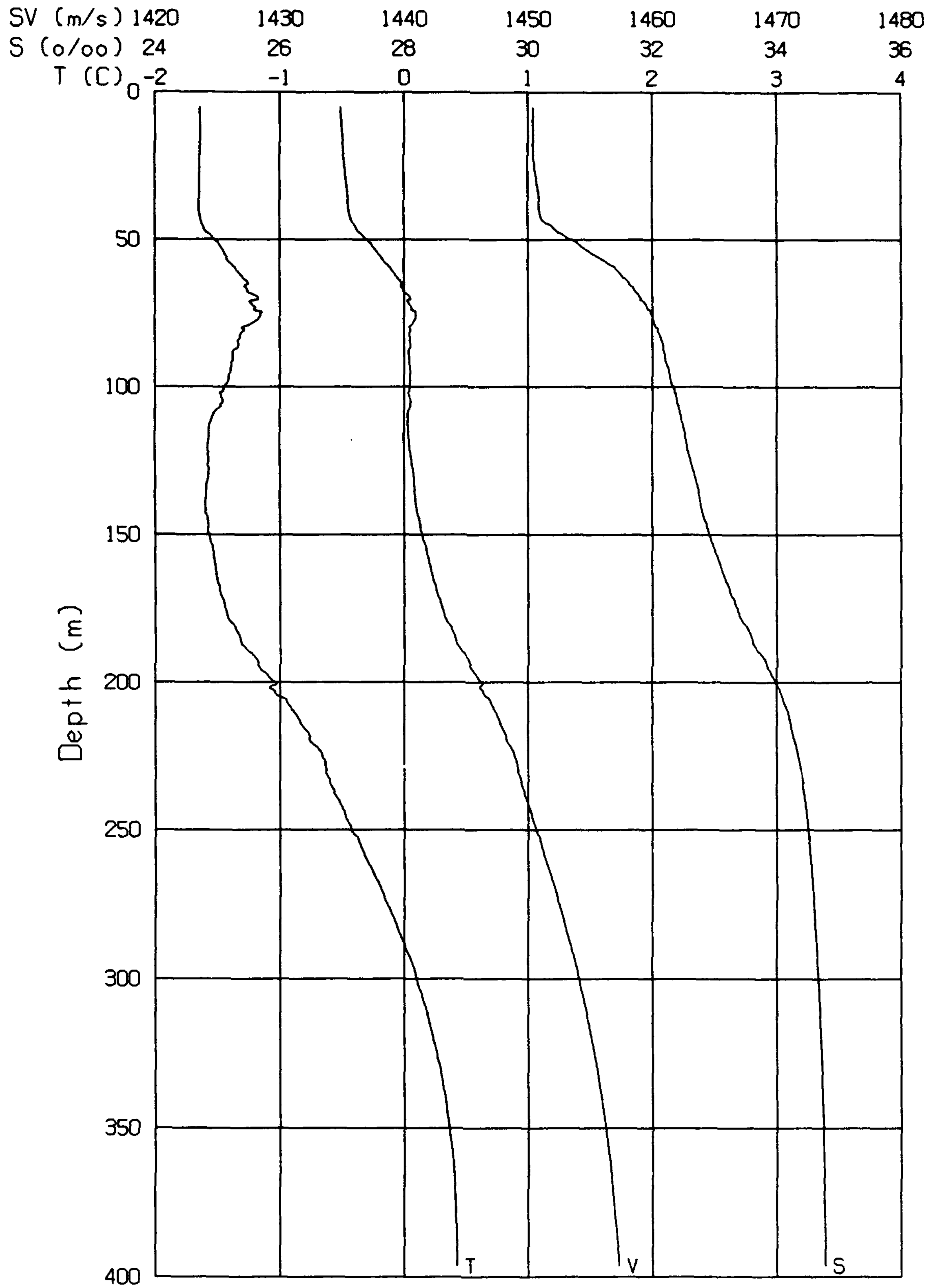

04-07-93 0751 CAST 022 72-38.5 N / 149-47.5 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0 50 100 150 200 250 300 350 400
T
V
S

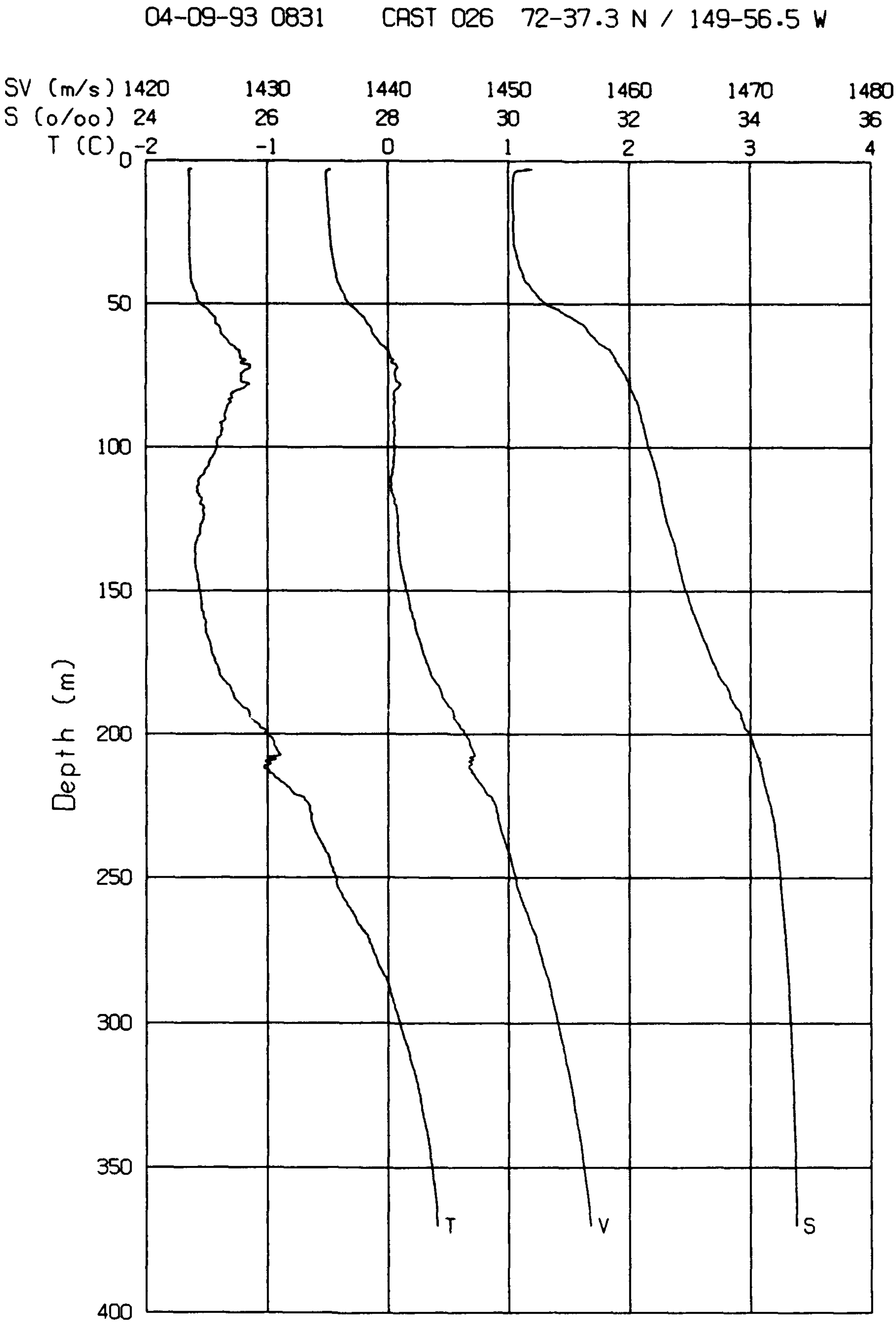

04-07-93 2014 CAST 023 72-38.1 N / 149-50.7 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

04-08-93 0914 CAST 024 72-37.8 N / 149-51.9 W

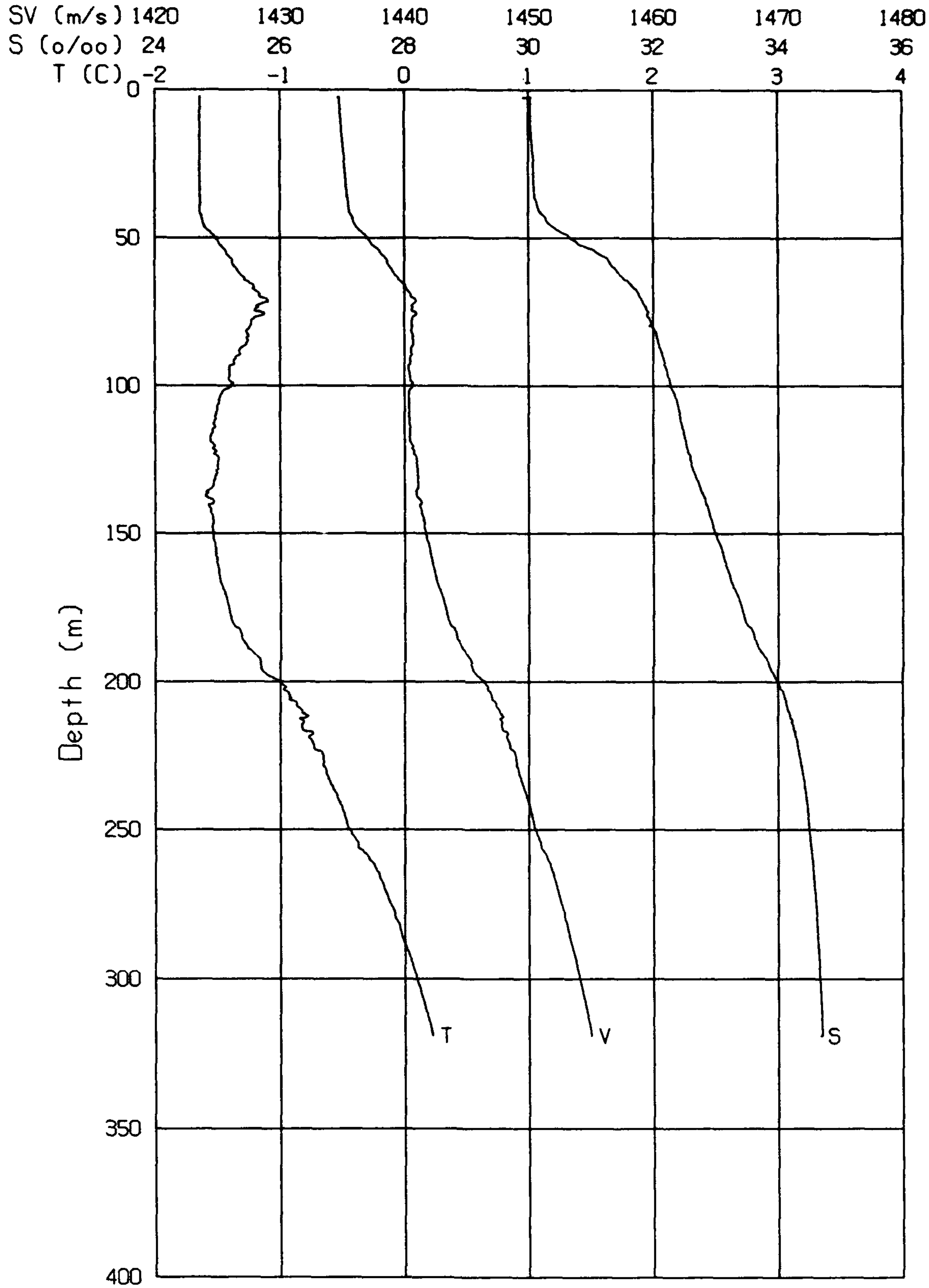


04-08-93 1844 CAST 025 72-37.5 N / 149-55.4 W

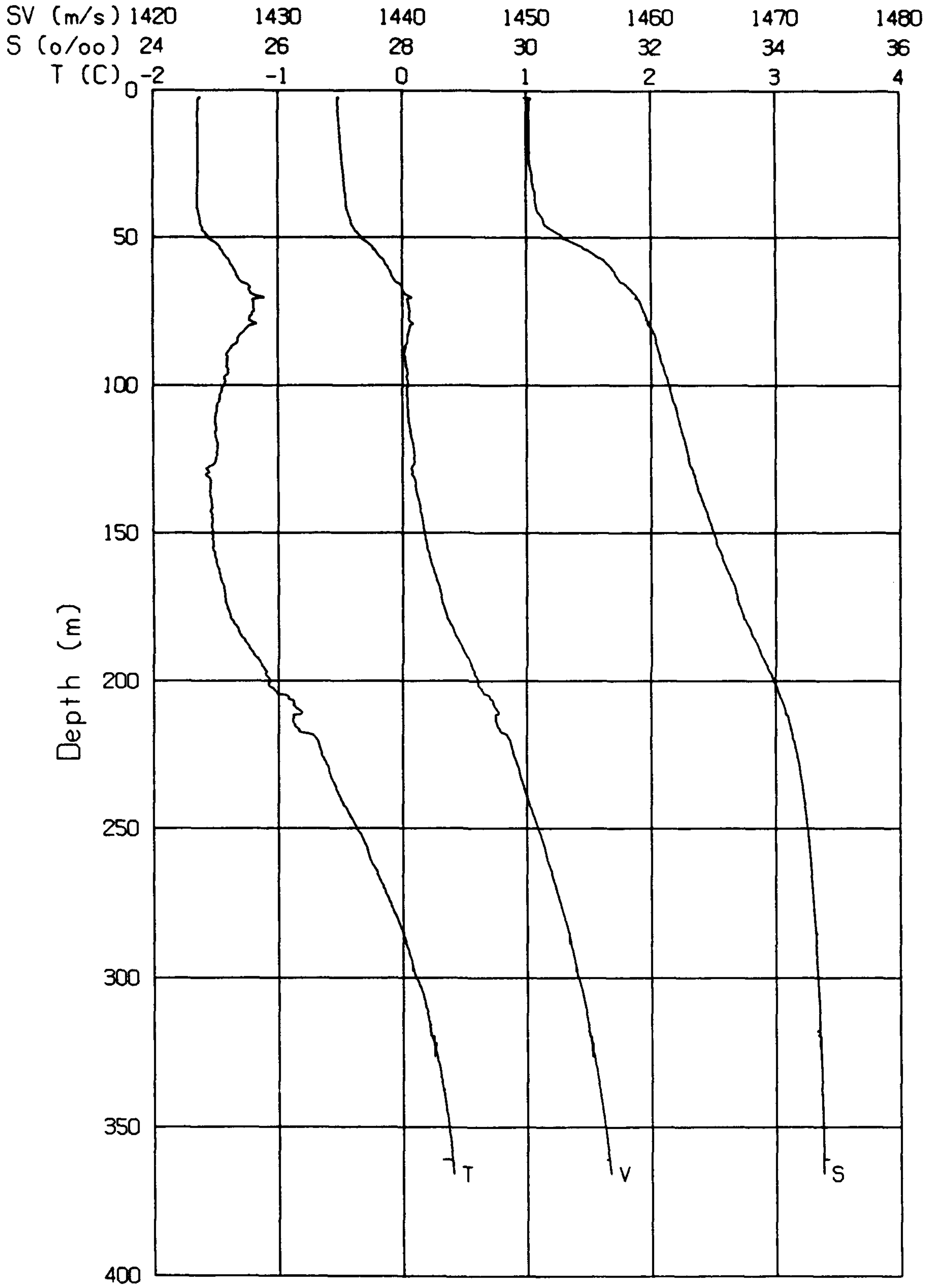



04-09-93 0831 CAST 026 72-37.3 N / 149-56.5 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

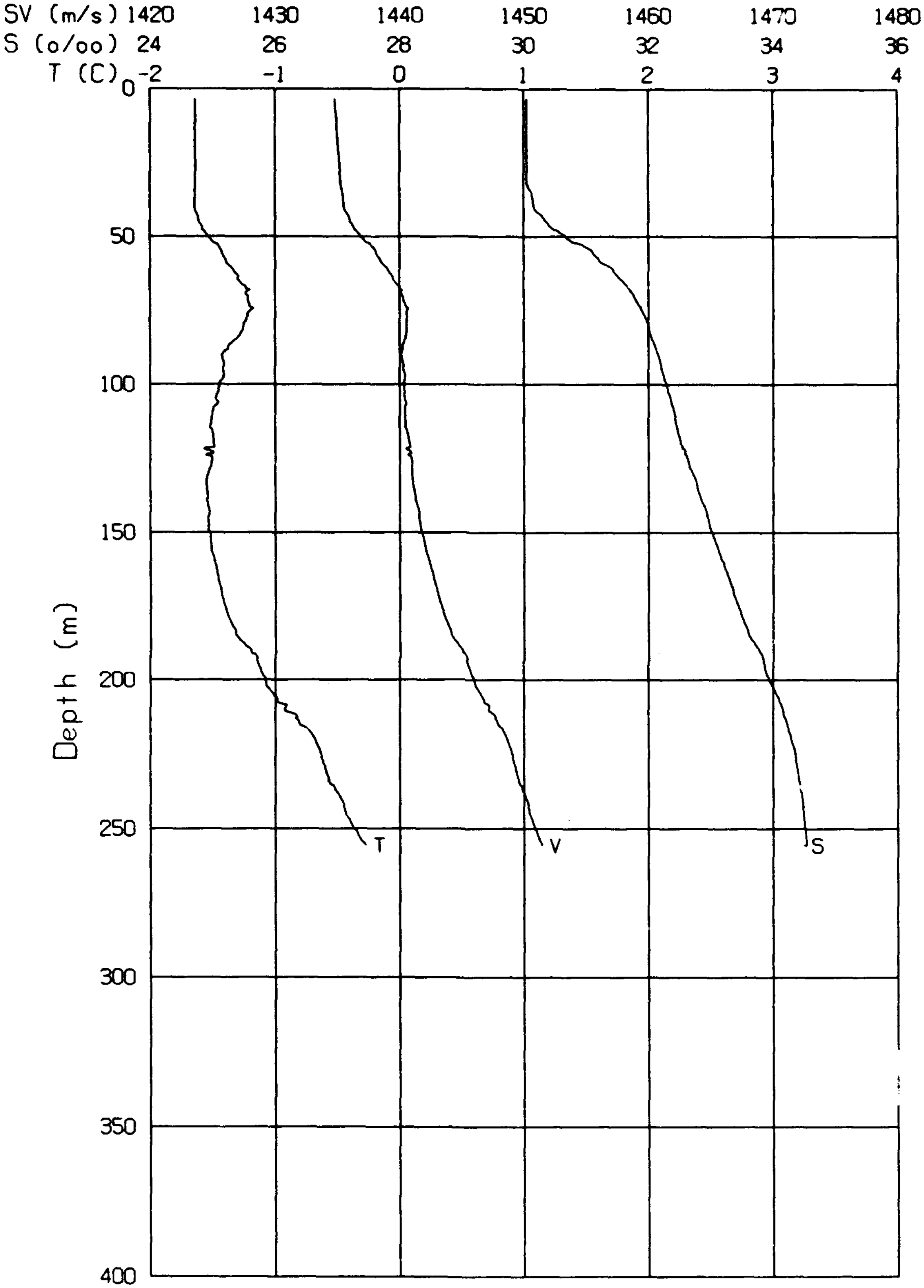
04-09-93 1427 CAST 027 72-37.3 N / 149-58.3 W

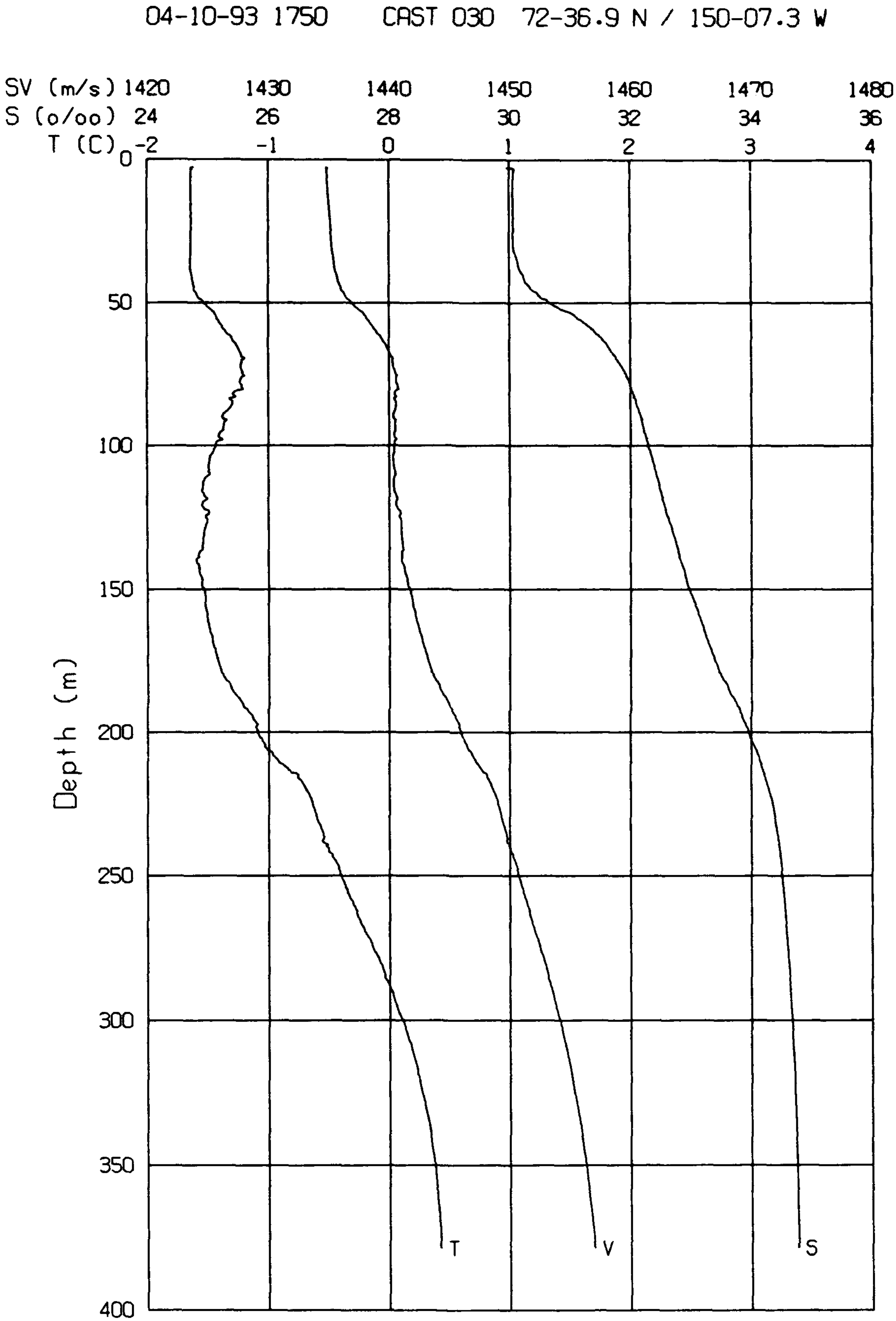


04-09-93 2239 CAST 028 72-36.9 N / 150-02.5 W



04-10-93 1232 CAST 029 72-36.9 N / 150-04.9W




04-10-93 1750 CAST 030 72-36.9 N / 150-07.3 W
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S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
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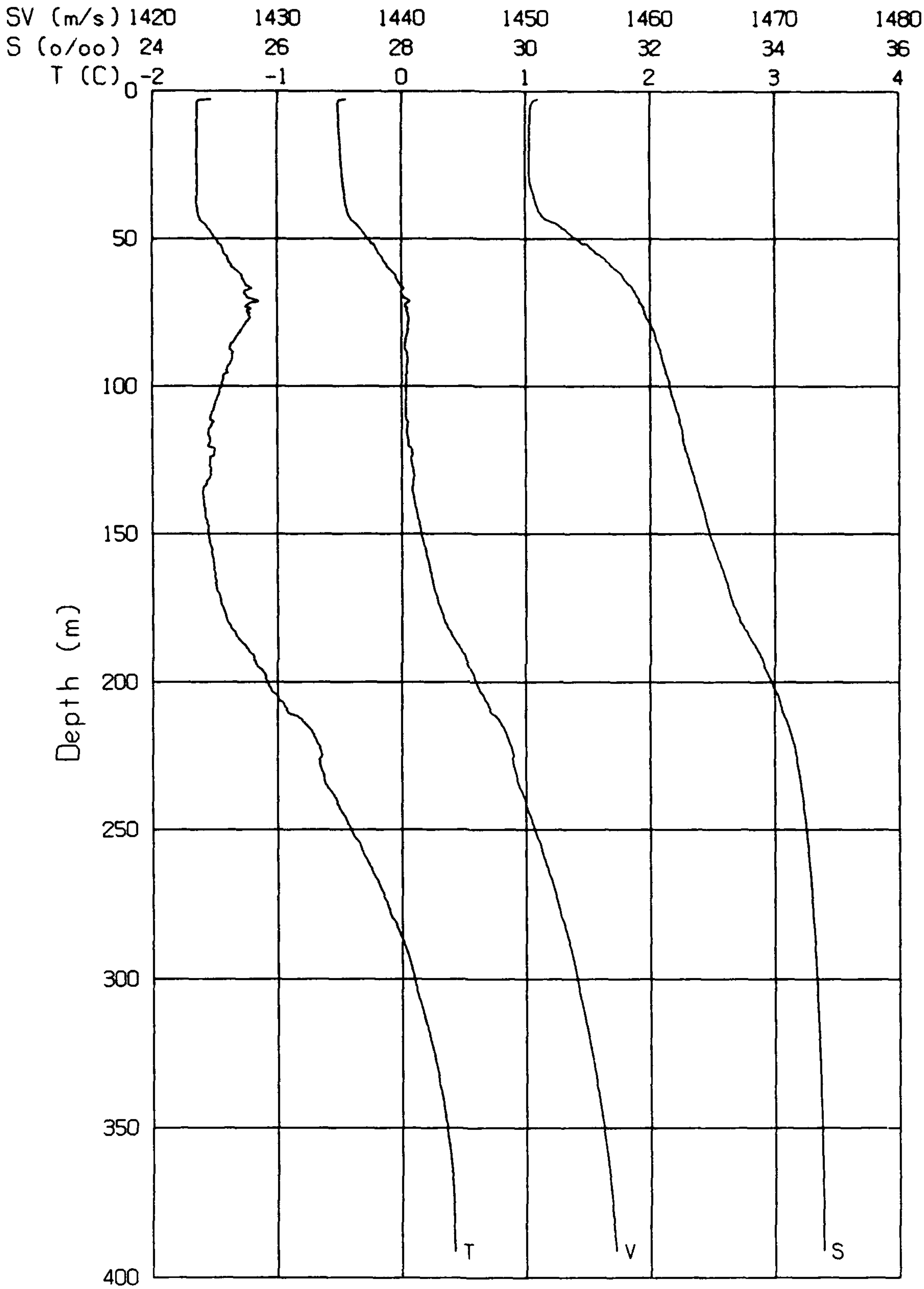
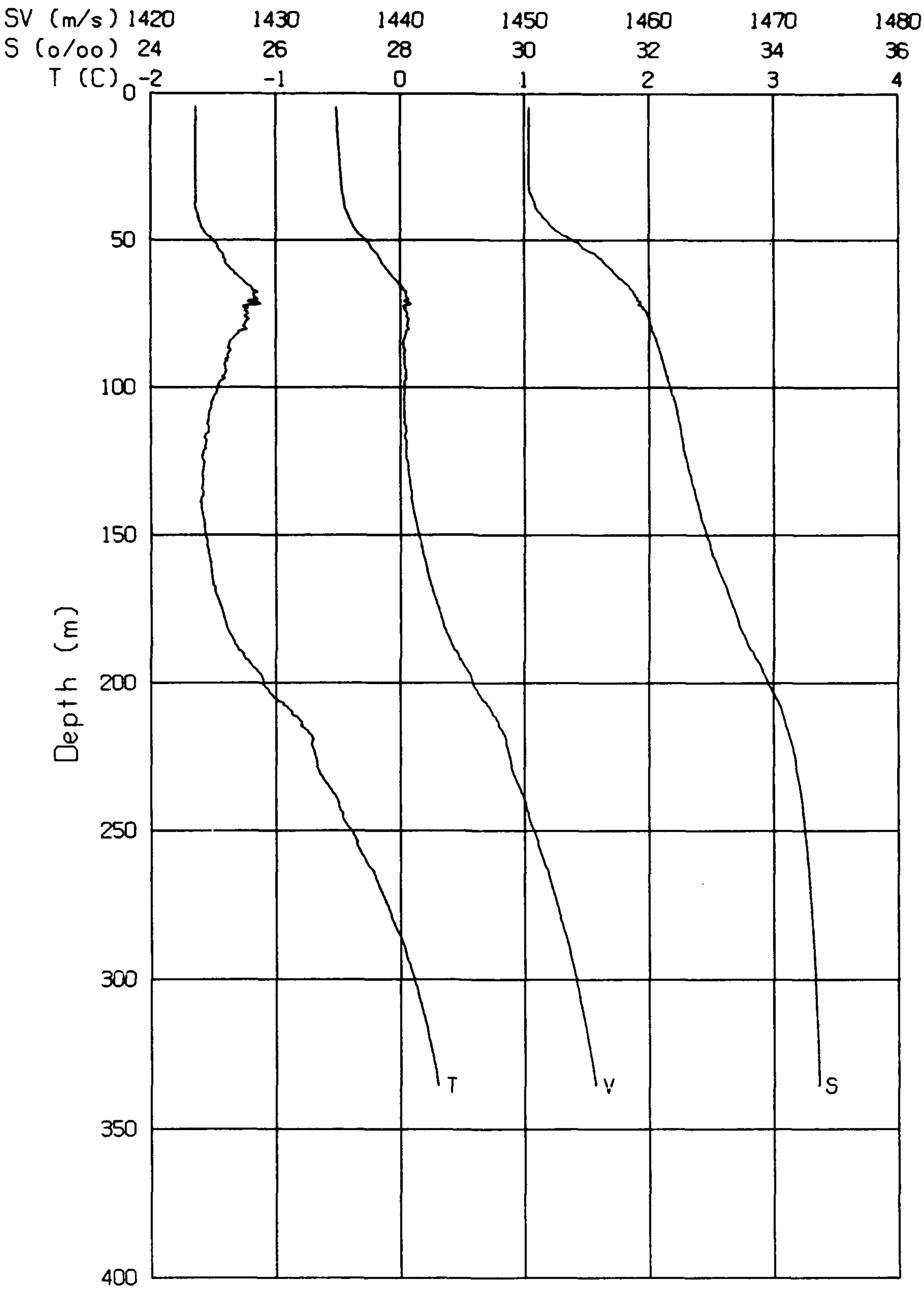
200
250
300
350
400
T
V
S

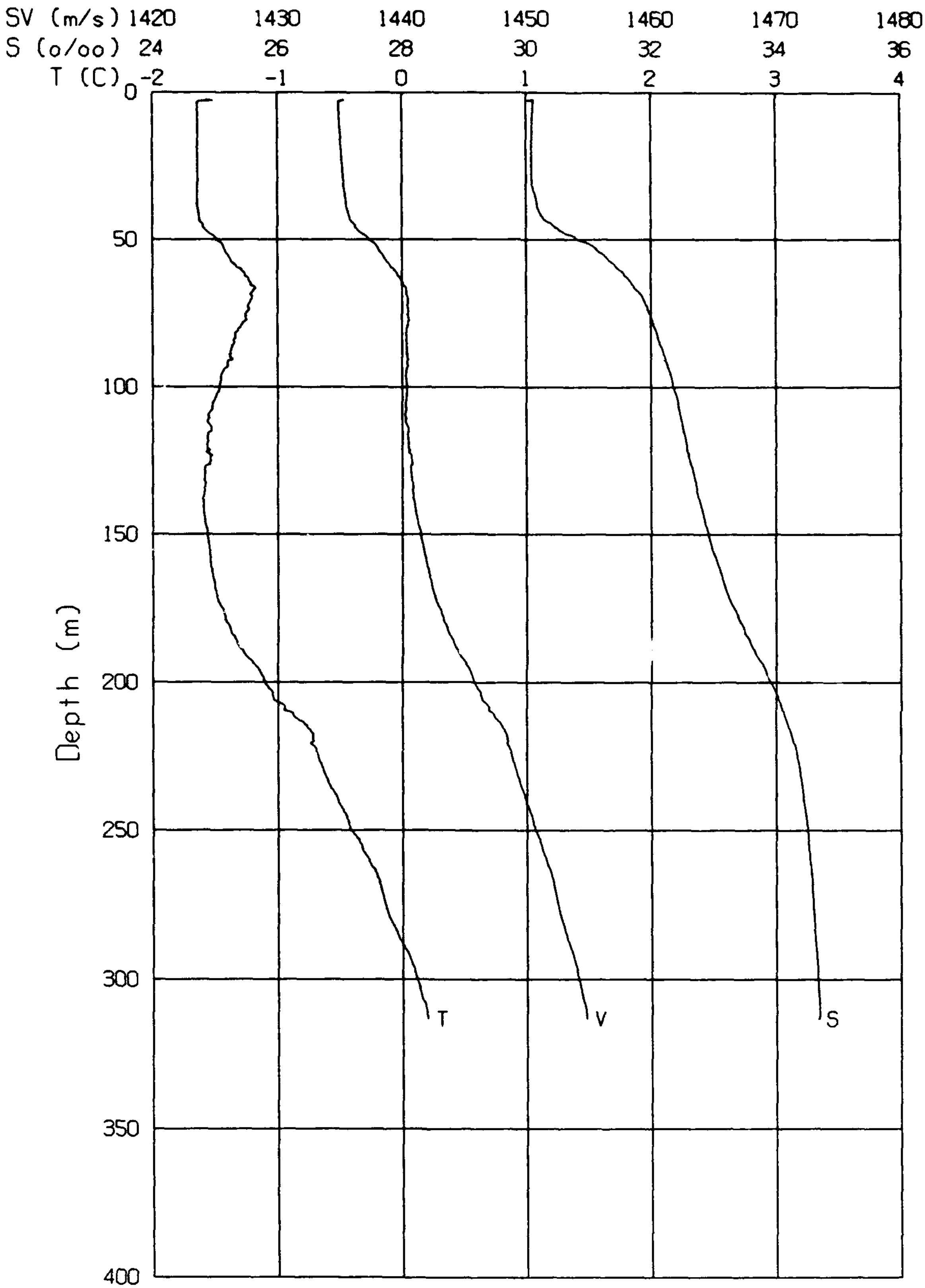
04-11-93 0656 CAST 031 72-36.9 N / 150-09.5 W

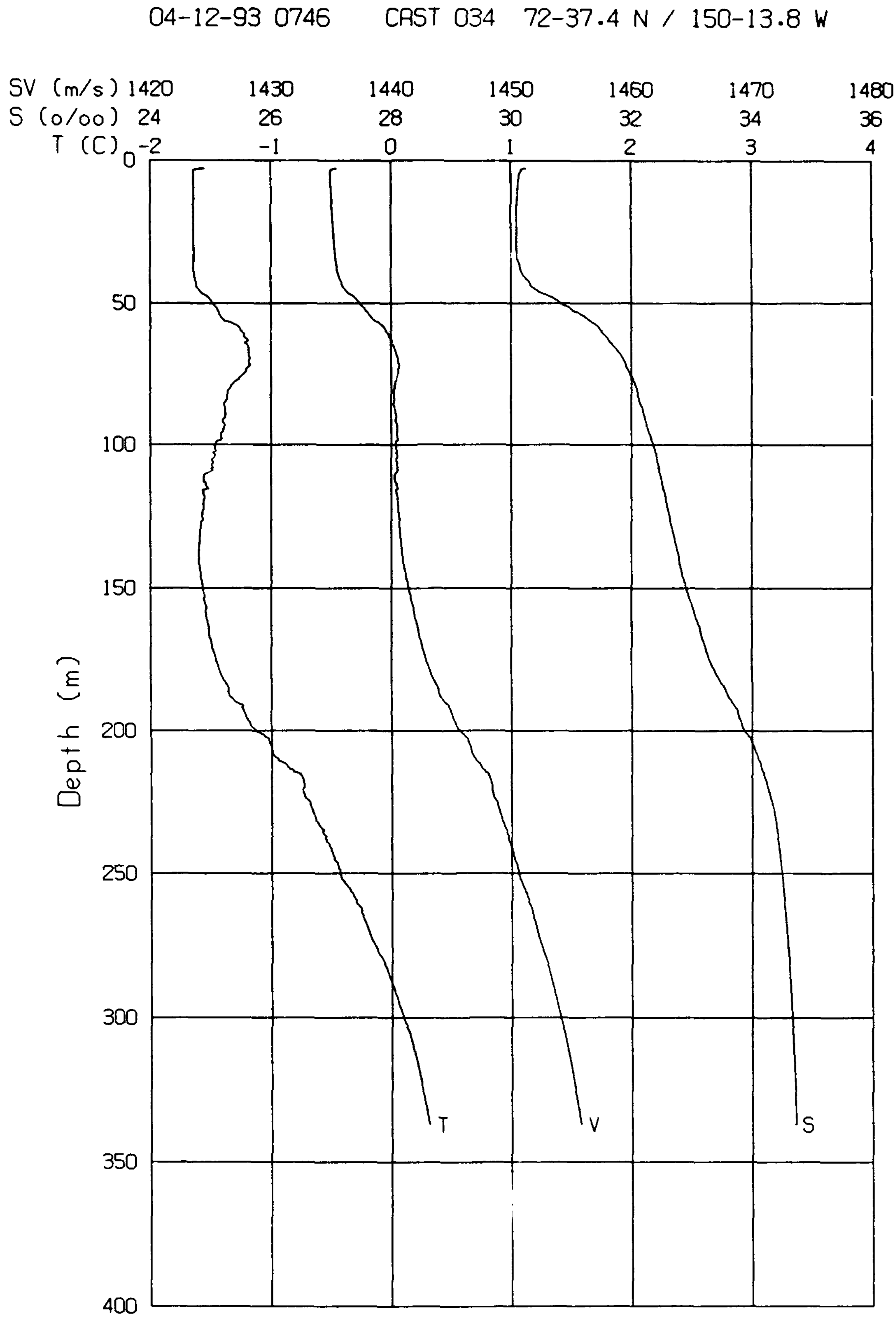


04-11-93 1424 CAST 032 72-36.9 N / 150-10.5 W



04-11-93 2340 CAST 033 72-37.2 N / 150-12.8 W

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SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

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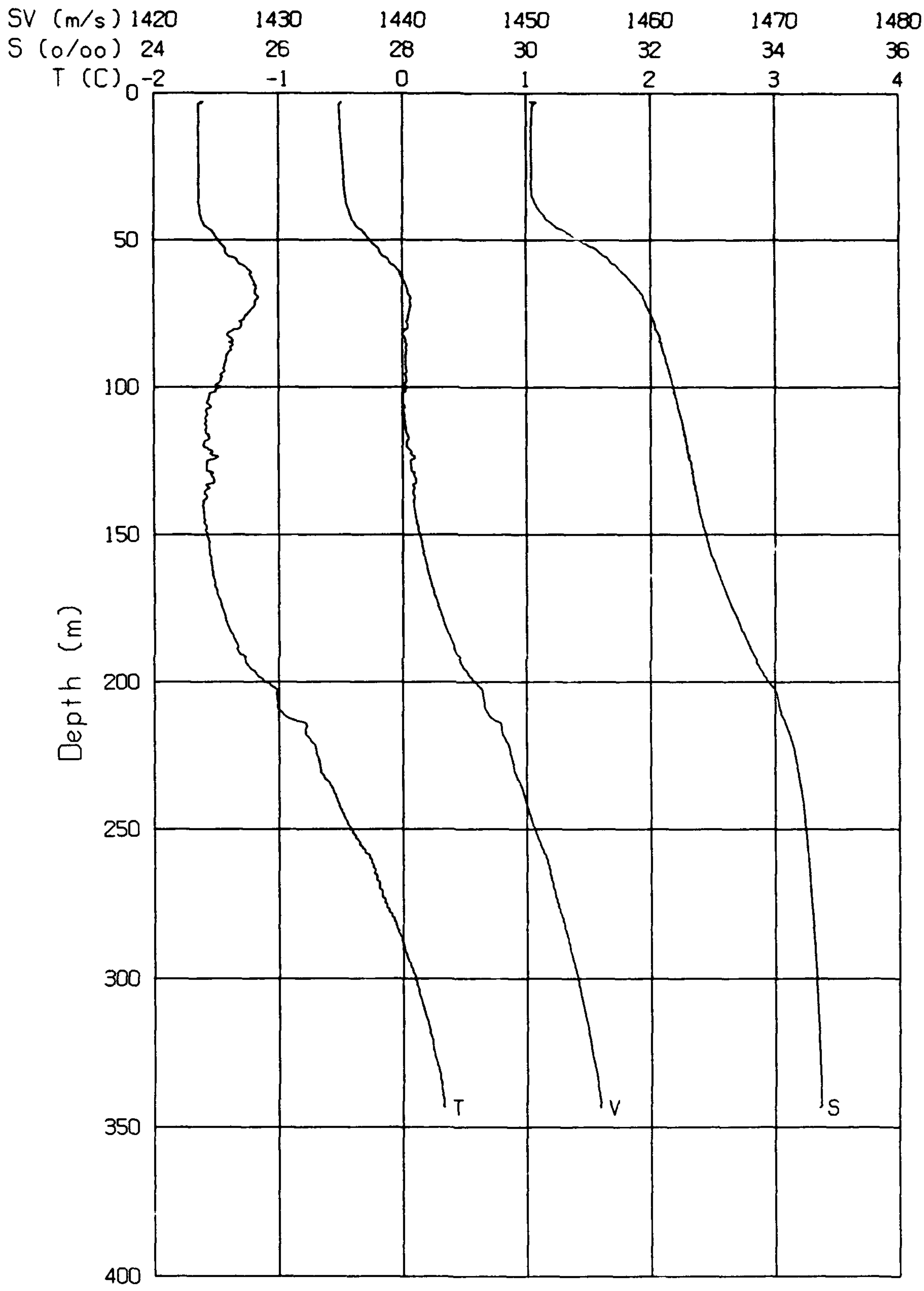

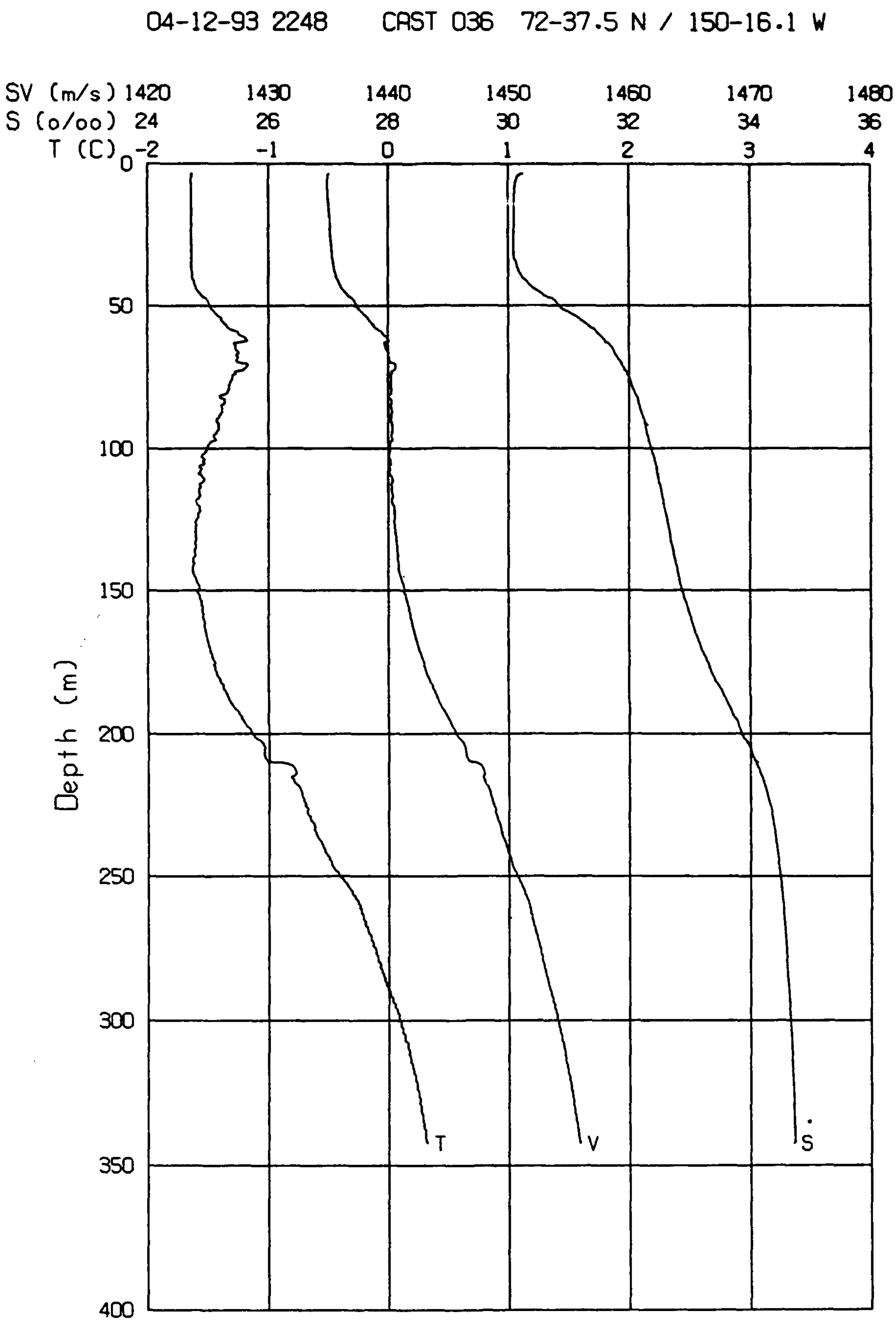
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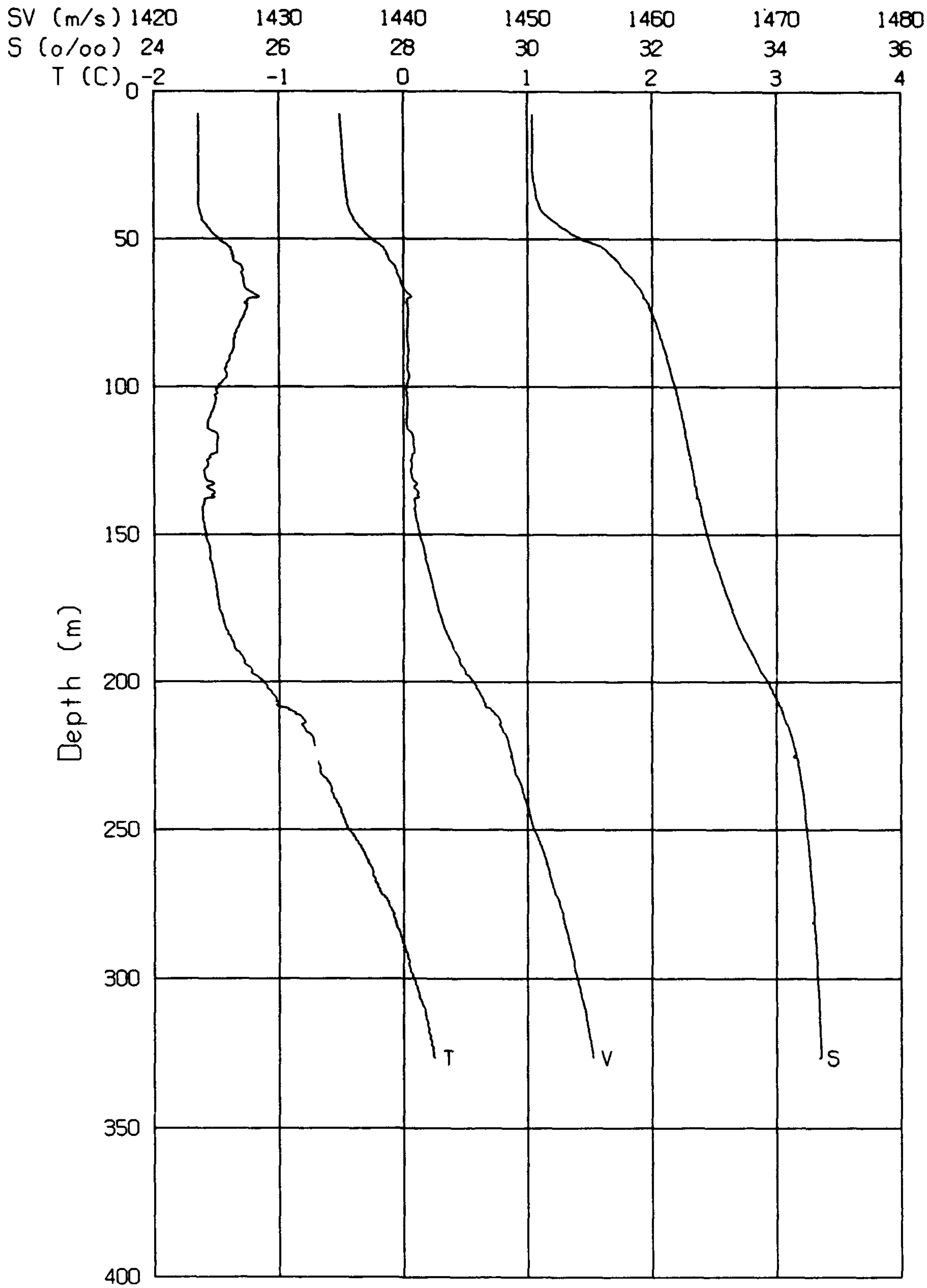
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
Depth (m)
0
50
100
150
200
250
300
350
400
T
V
S

04-13-93 0754 CAST 037 72-37.7 N / 150-18.0 W



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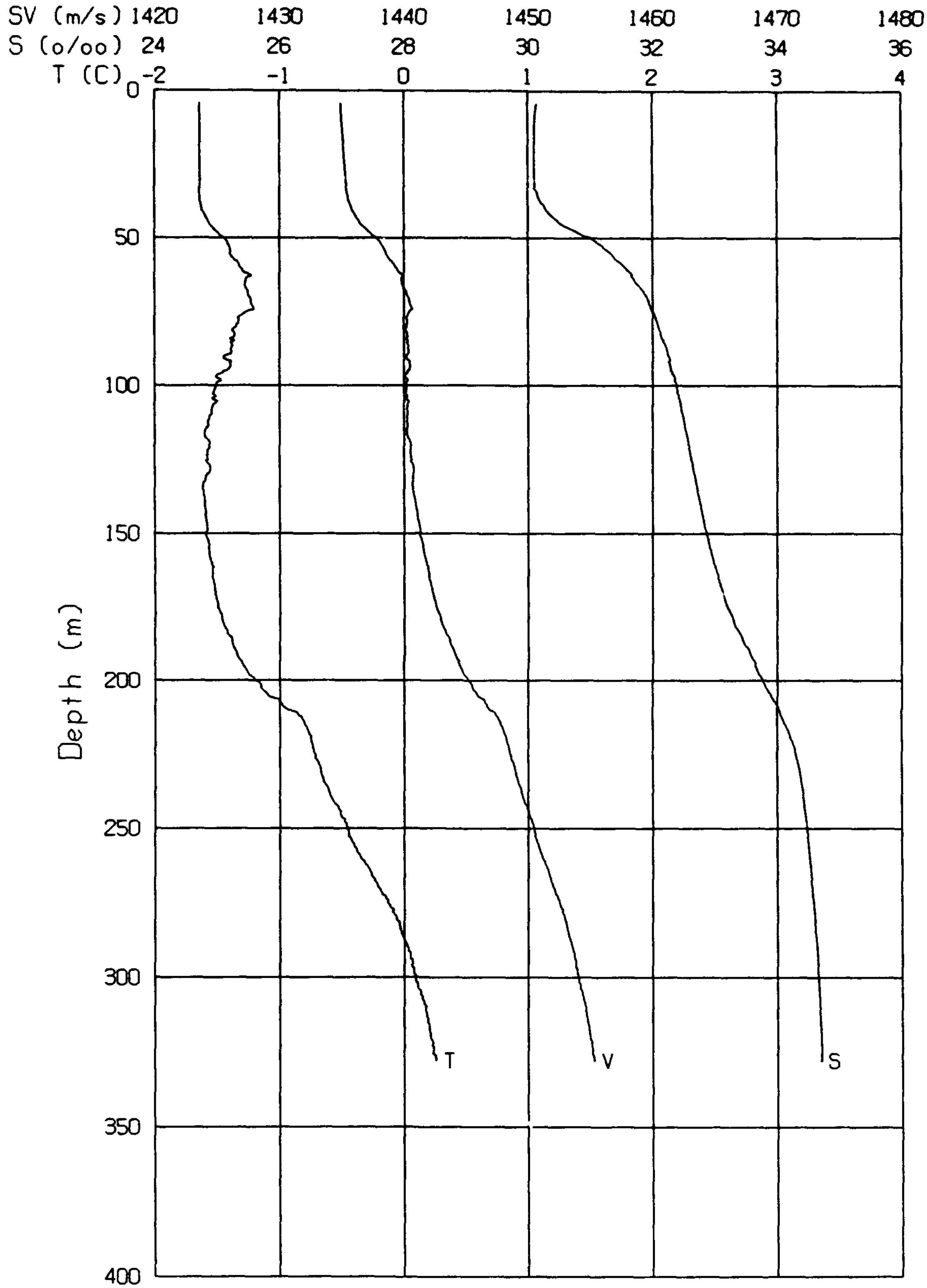
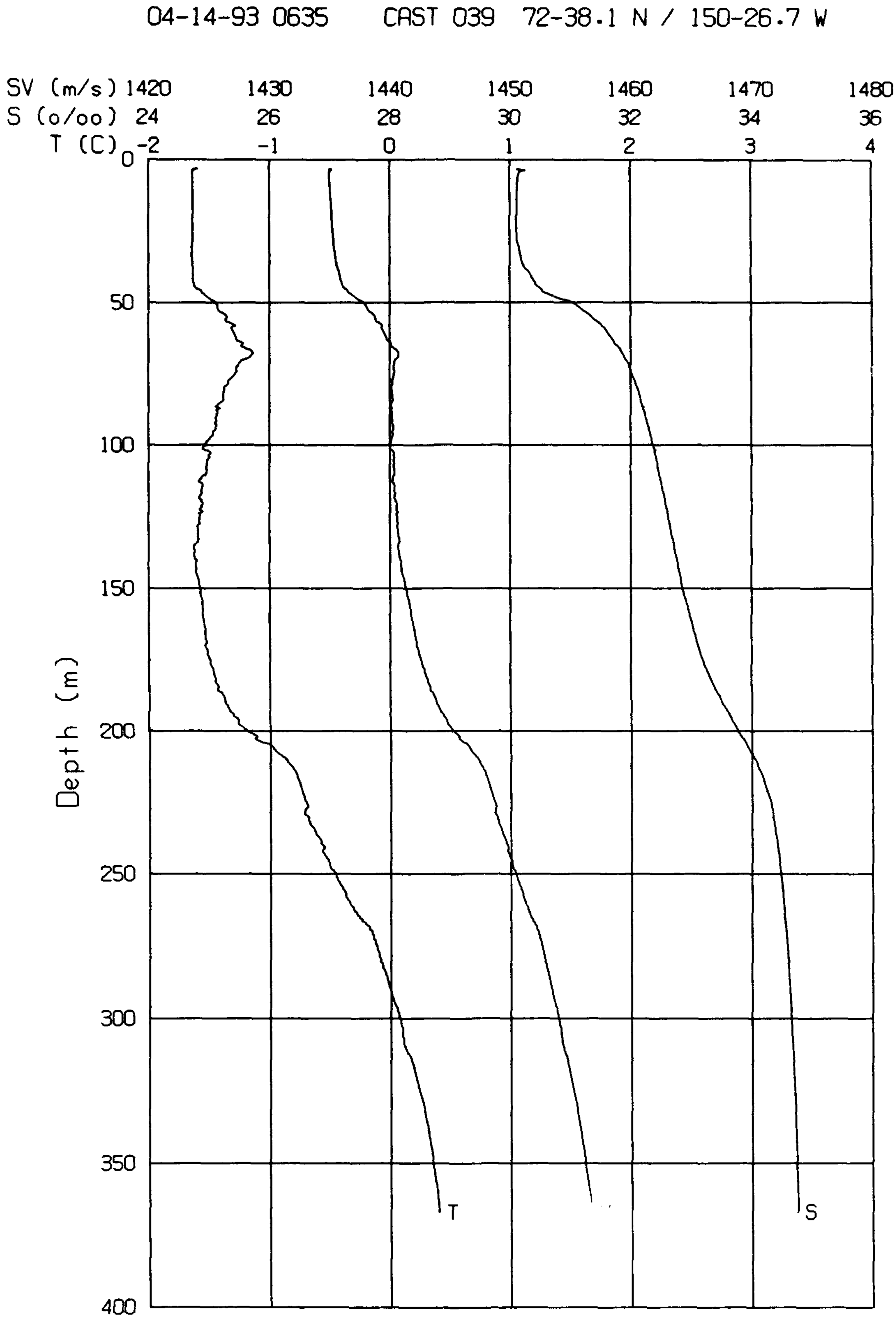
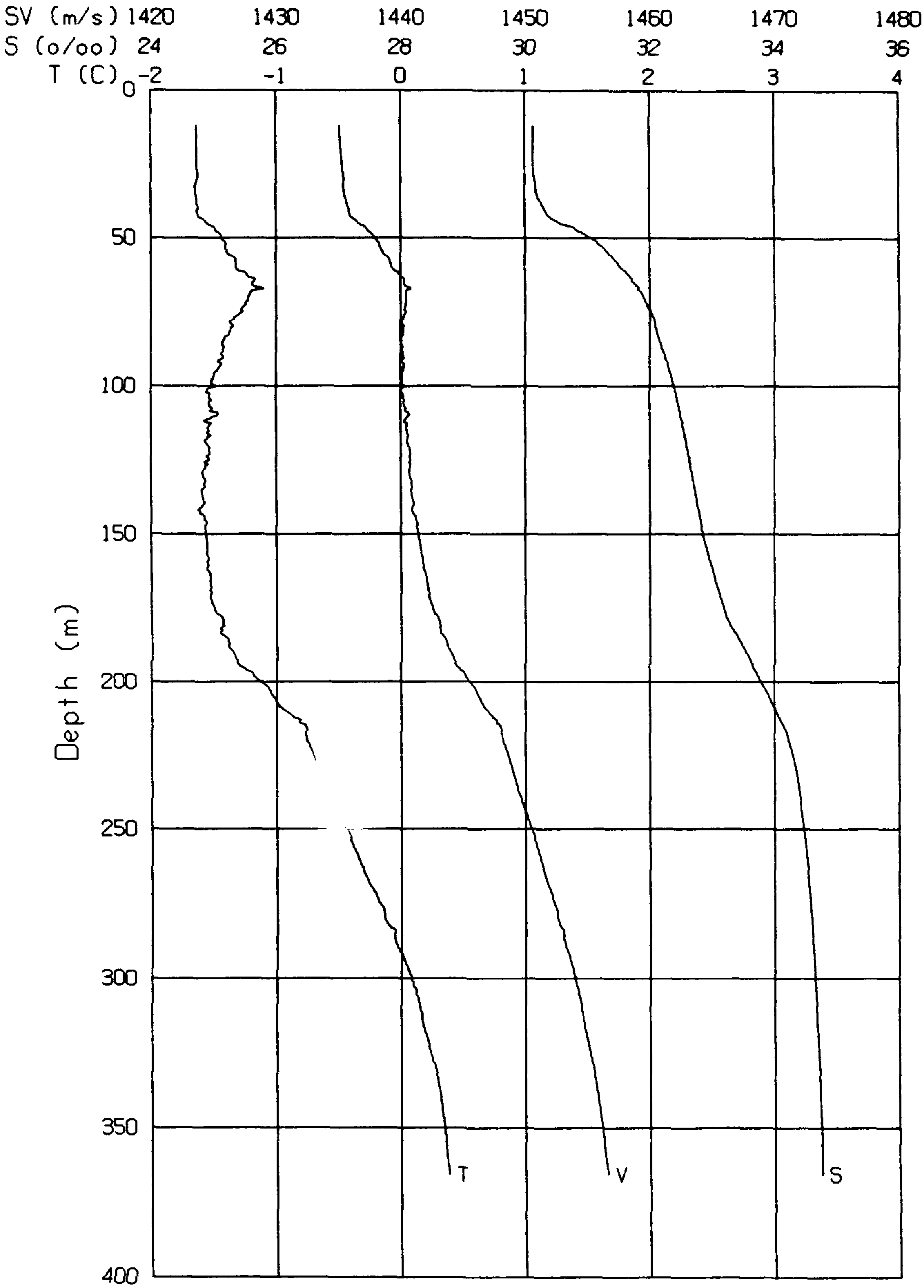



04-14-93 0635 CAST 039 72-38.1 N / 150-26.7 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
0
50
100
150
200
250
300
350
400
Depth (m)
T
S

04-14-93 1418 CAST 040 72-38.1 N / 150-30.2 W



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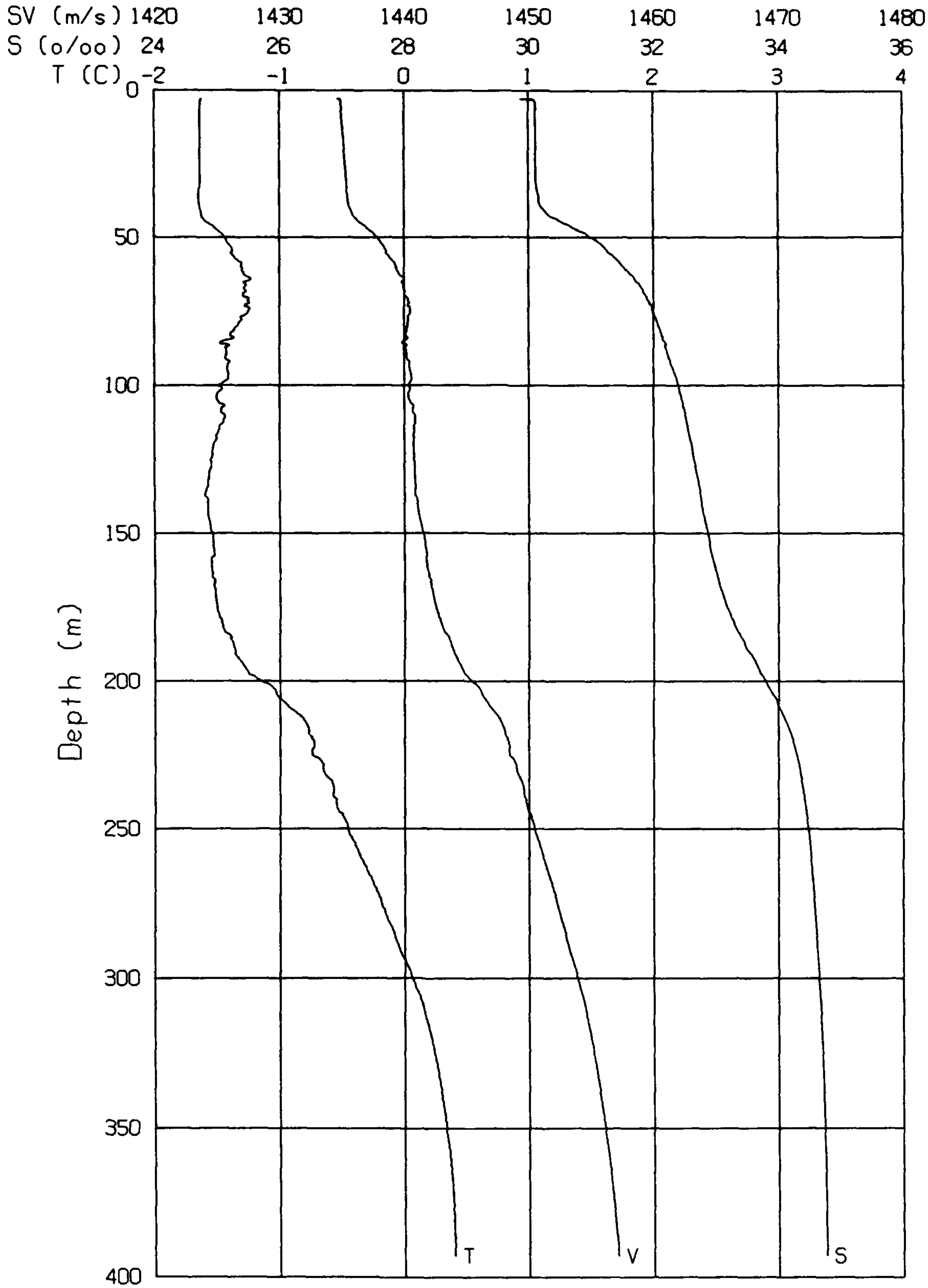

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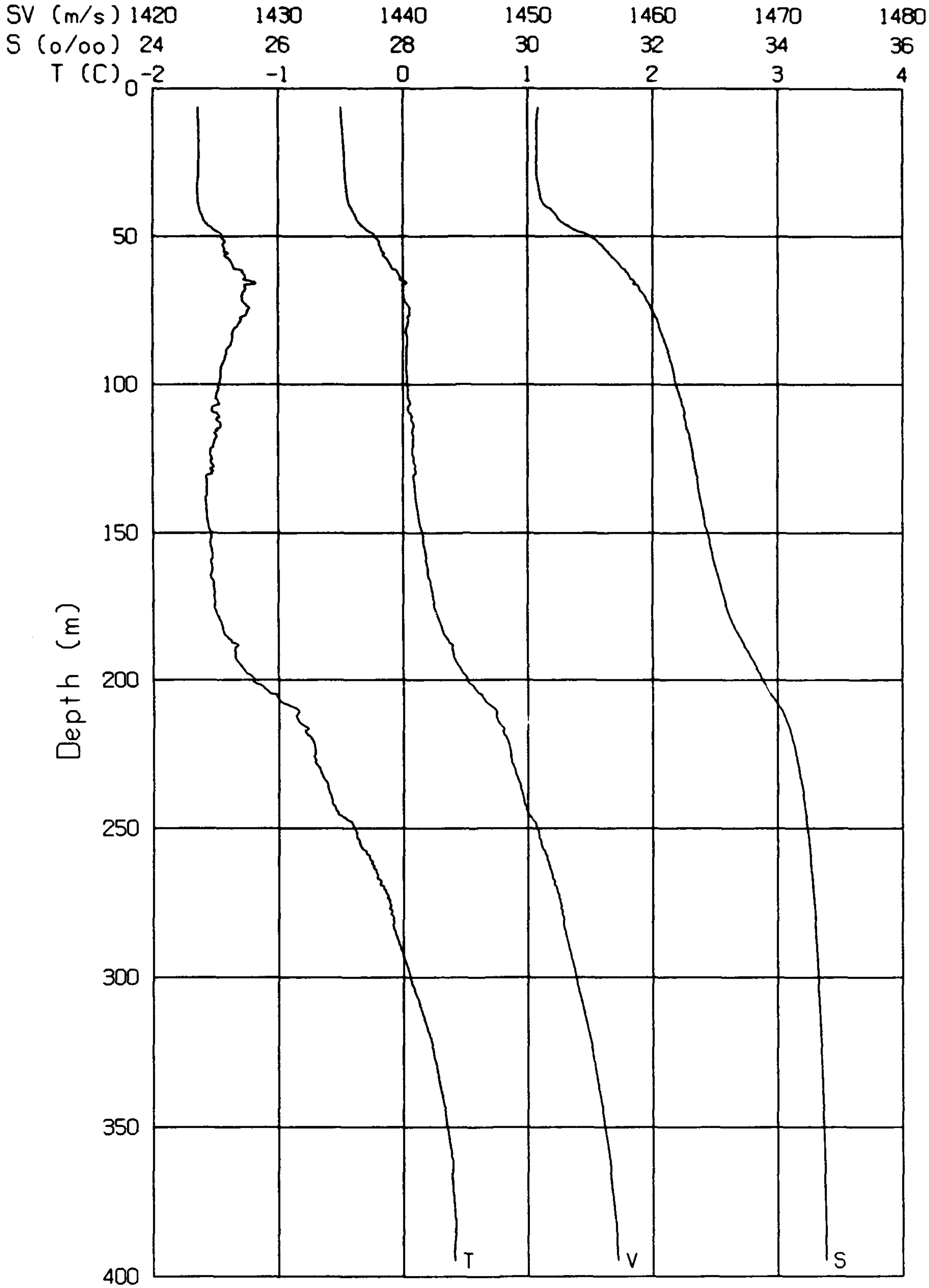
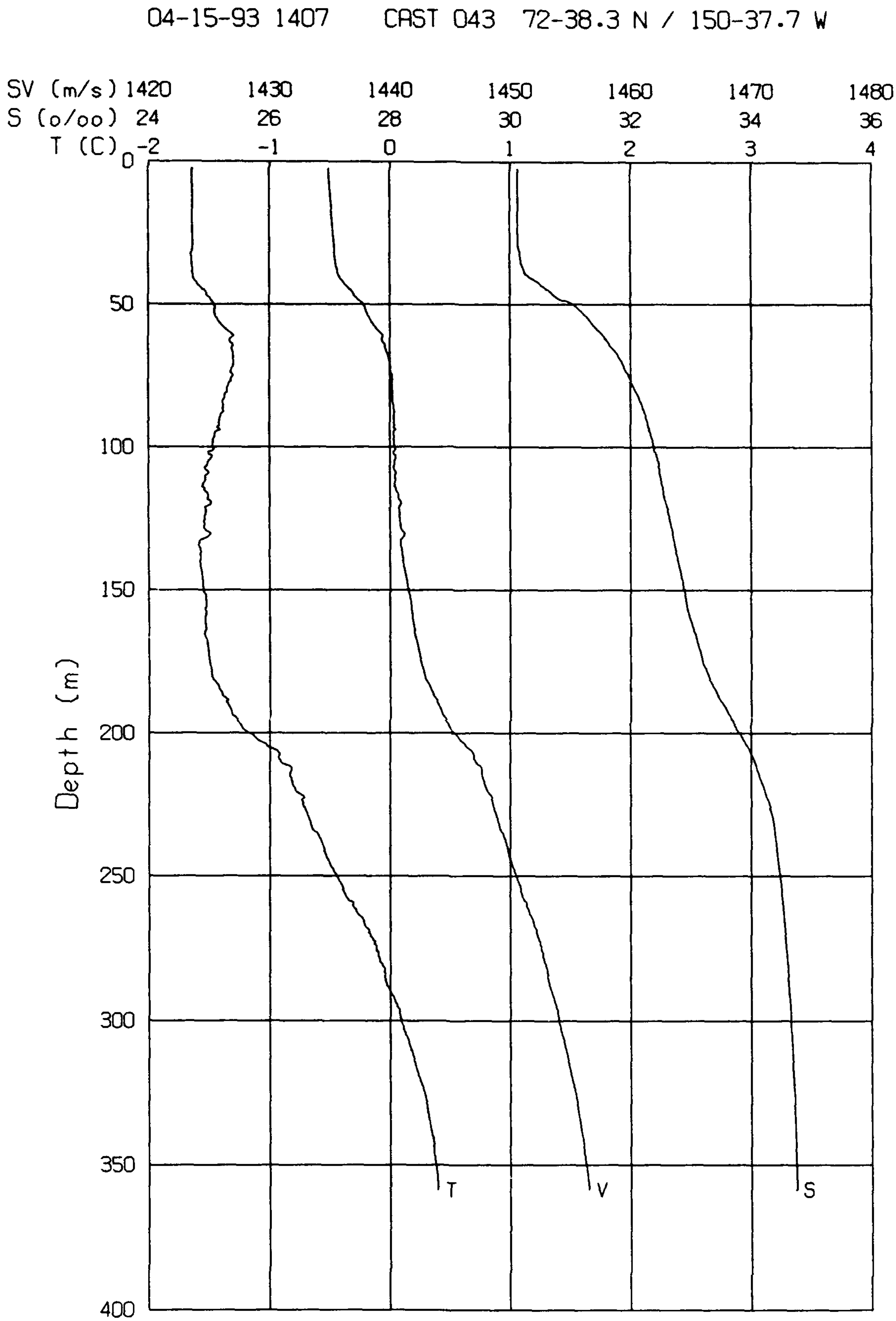


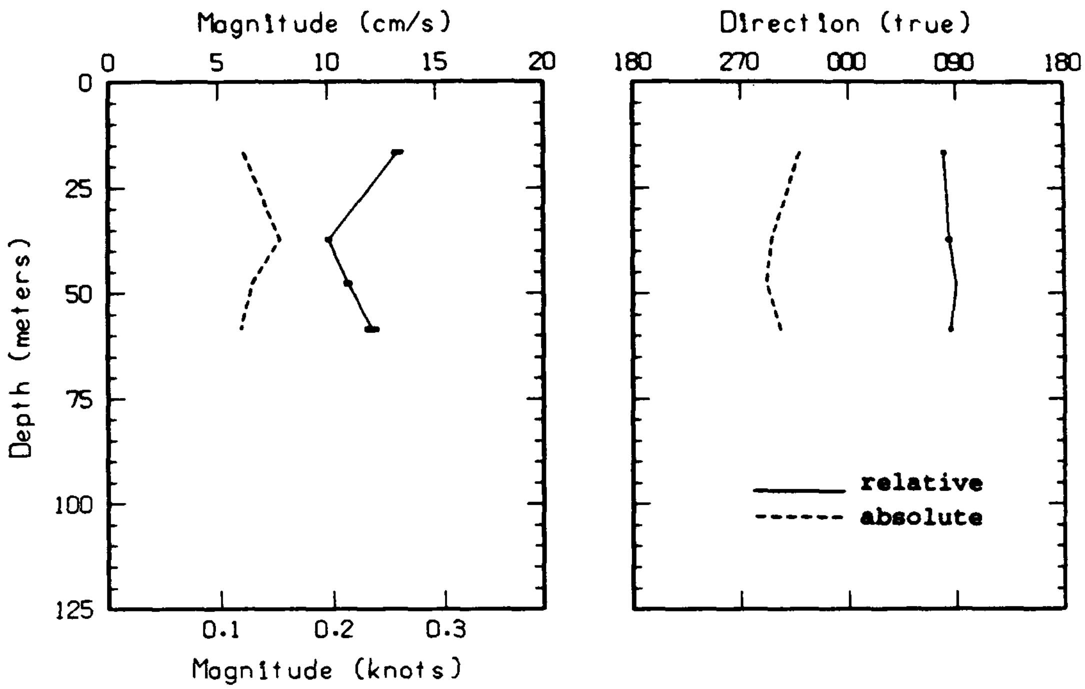

04-15-93 1407 CAST 043 72-38.3 N / 150-37.7 W
SV (m/s) 1420 1430 1440 1450 1460 1470 1480
S (o/oo) 24 26 28 30 32 34 36
T (C) -2 -1 0 1 2 3 4
0
50
100
150
200
250
300
350
400
Depth (m)
T
V
S

APPENDIX C

Current Meter Data

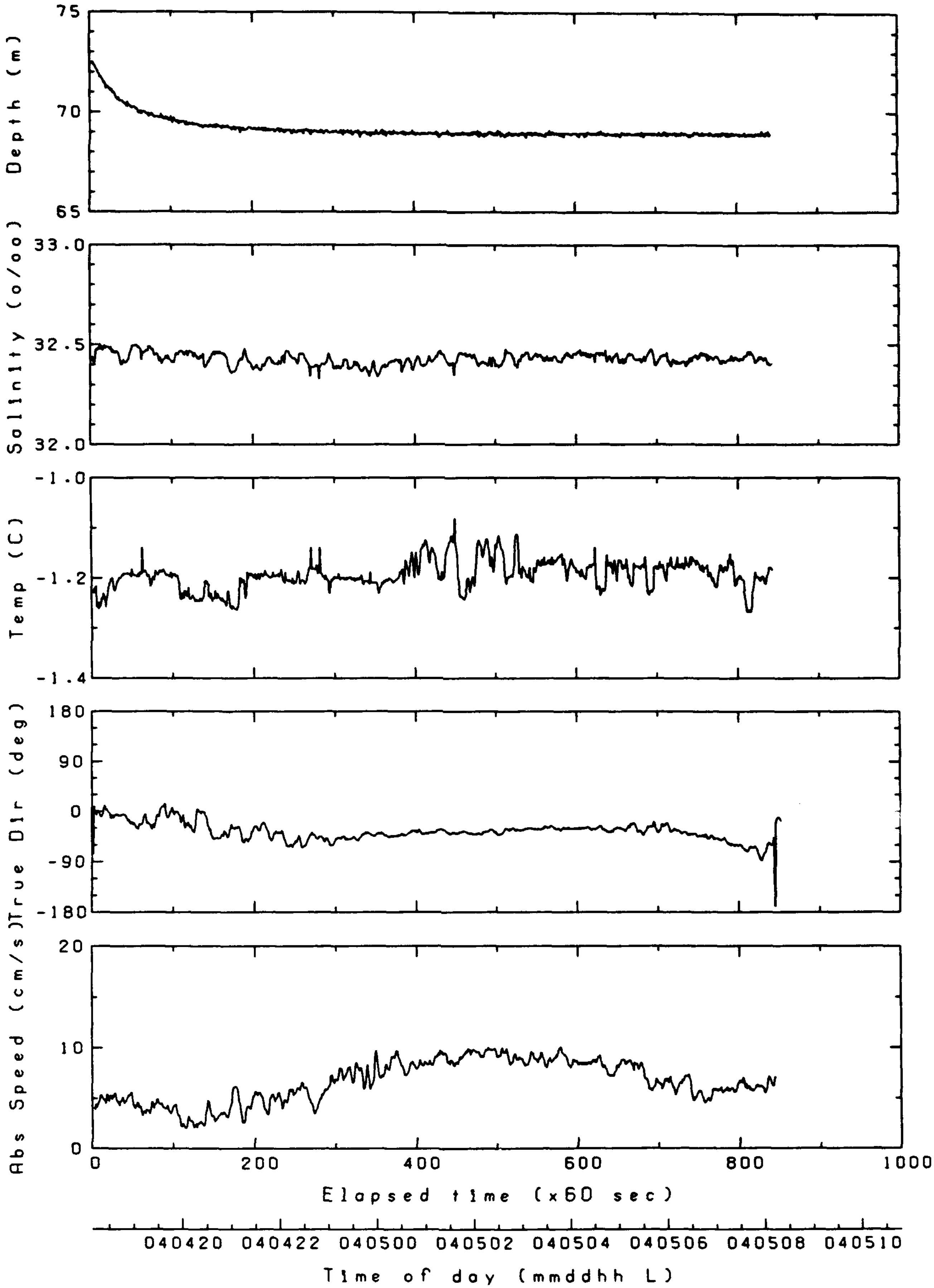
mmdd	hhmm (Local)	Cast	Floe Drift Ave (s)	cm/s	Dir	Comments
0401	1635	1	60	17.3	278	
0404	1810	2	60	12.0	281	Time series at 70 m
0405	1745	3	5	10.0	295	
0408	1145	4	5	4.8	254	
0409	1645	5	5	9.9	268	
0410	1815	6	5	4.9	280	
0411	1456	7	5	5.3	289	Time series at 225 m
0413	0915	8	5	5.0	286	Time series at 220 m

04/01 1635L Cast 1

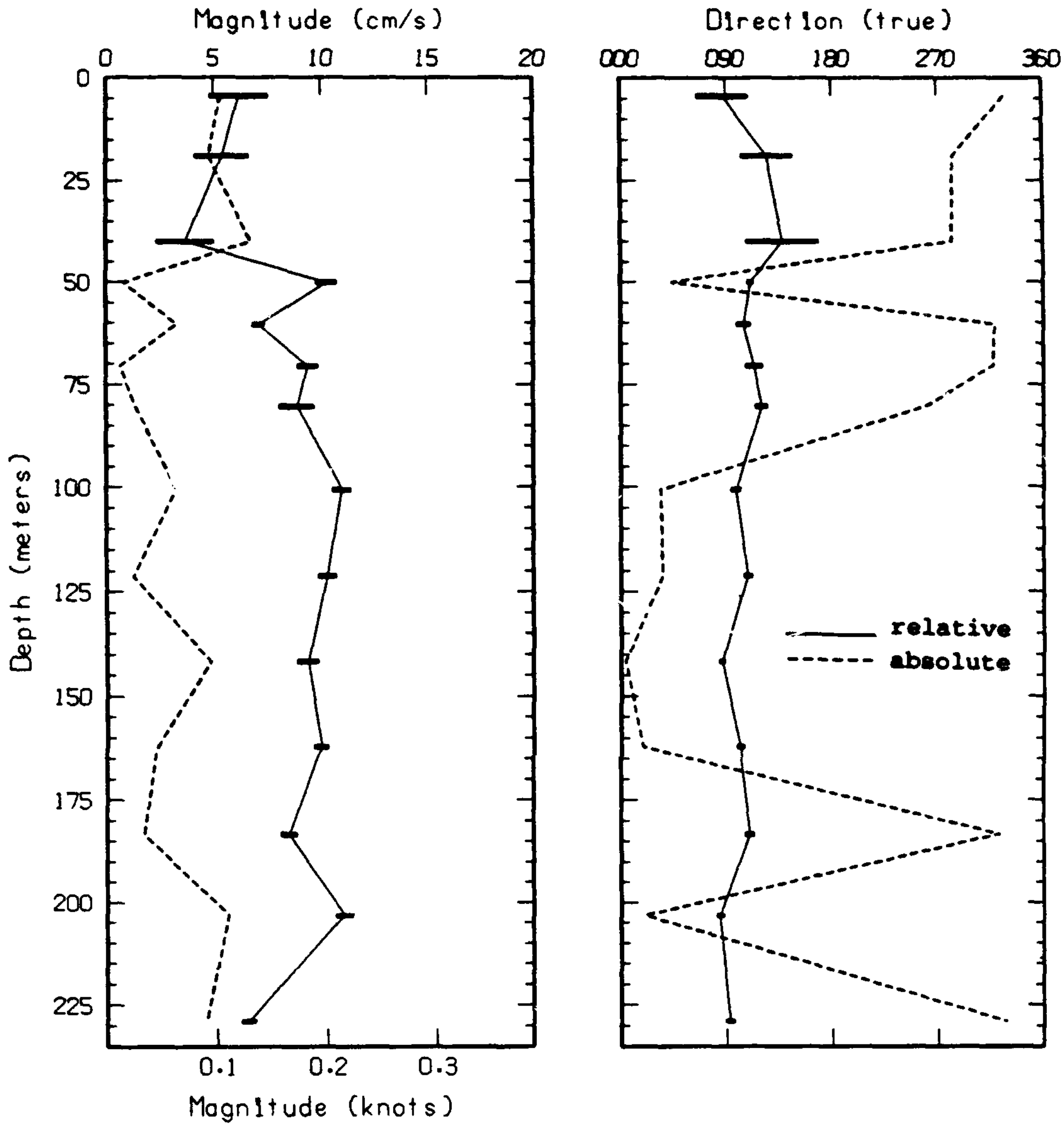


Magnetic bearing + 31 degrees = True bearing
Floe drift speed = 17.3 cm/s
Floe drift direction = 278 degrees True bearing

04/04 1810L Cast 2

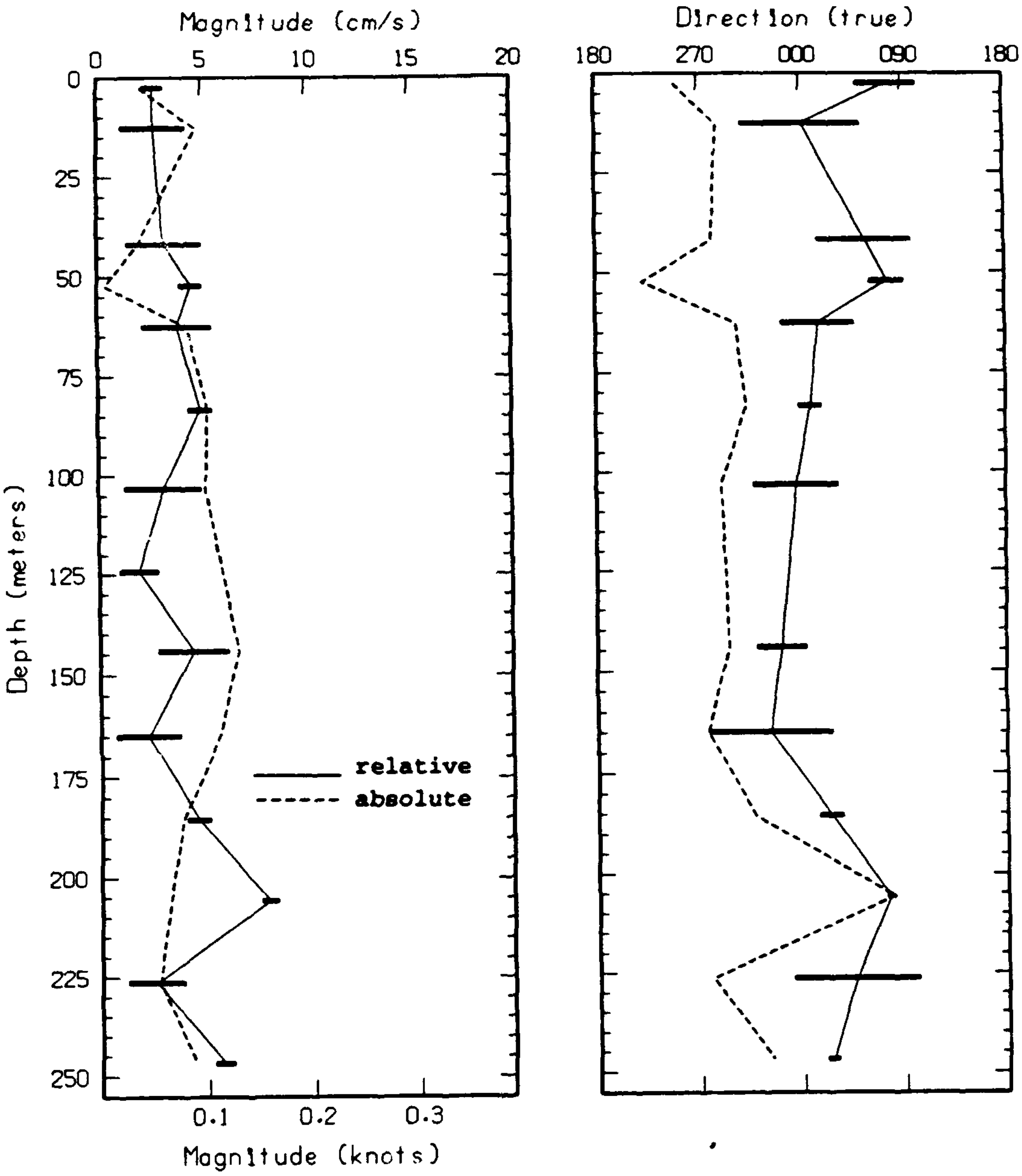


04/05 1745L Cast 3



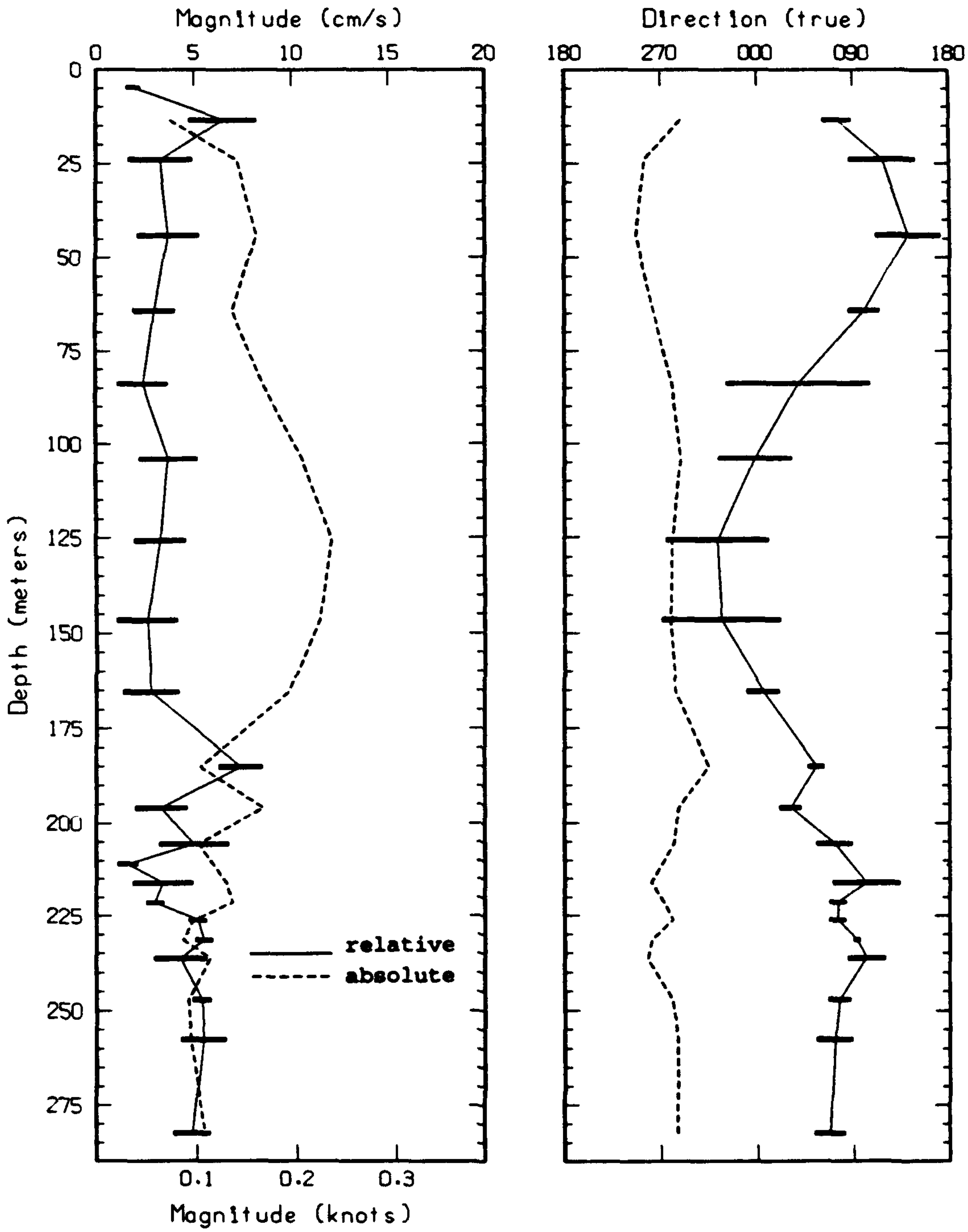
Magnetic bearing + 31 degrees = True bearing
Floe drift speed = 10.0 cm/s
Floe drift direction = 295 degrees True bearing

04/08 1145L Cast 4



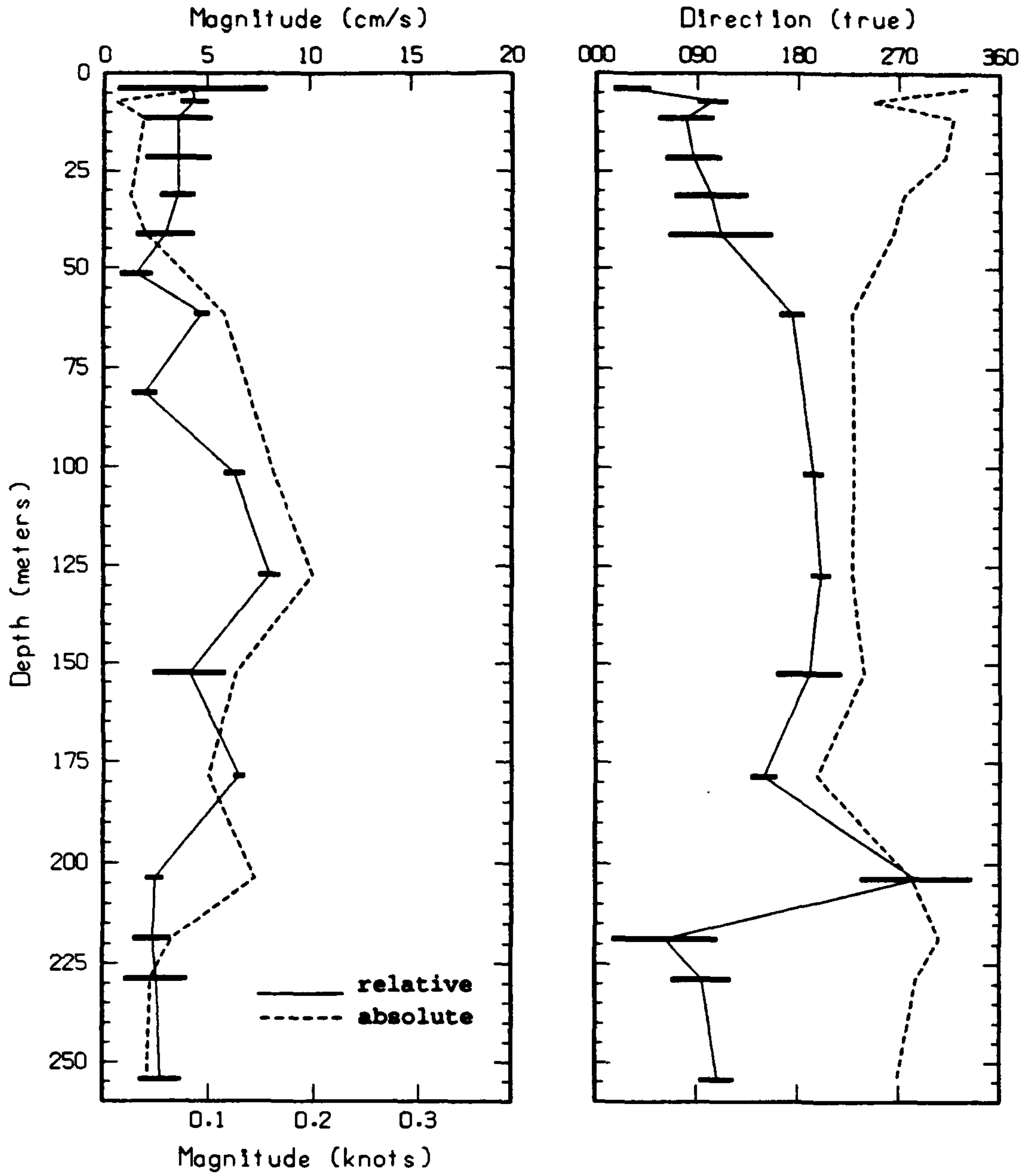
Magnetic bearing + 31 degrees = True bearing
Floe drift speed = 4.8 cm/s
Floe drift direction = 254 degrees True bearing

04/09 1645L Cast 5



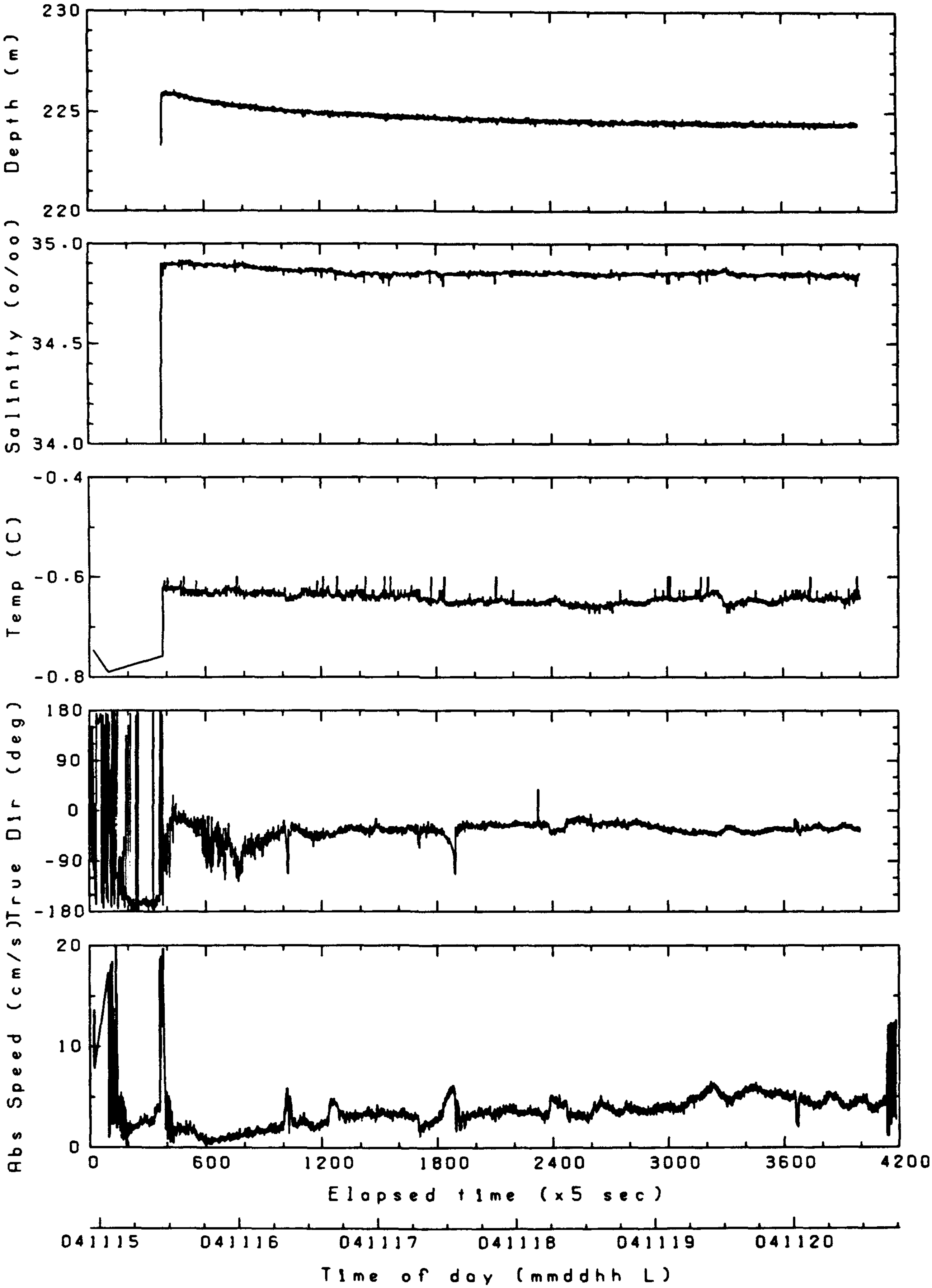
Magnetic bearing + 31 degrees = True bearing
Floe drift speed = 9.9 cm/s
Floe drift direction = 268 degrees True bearing

04/10 1815L Cast 6

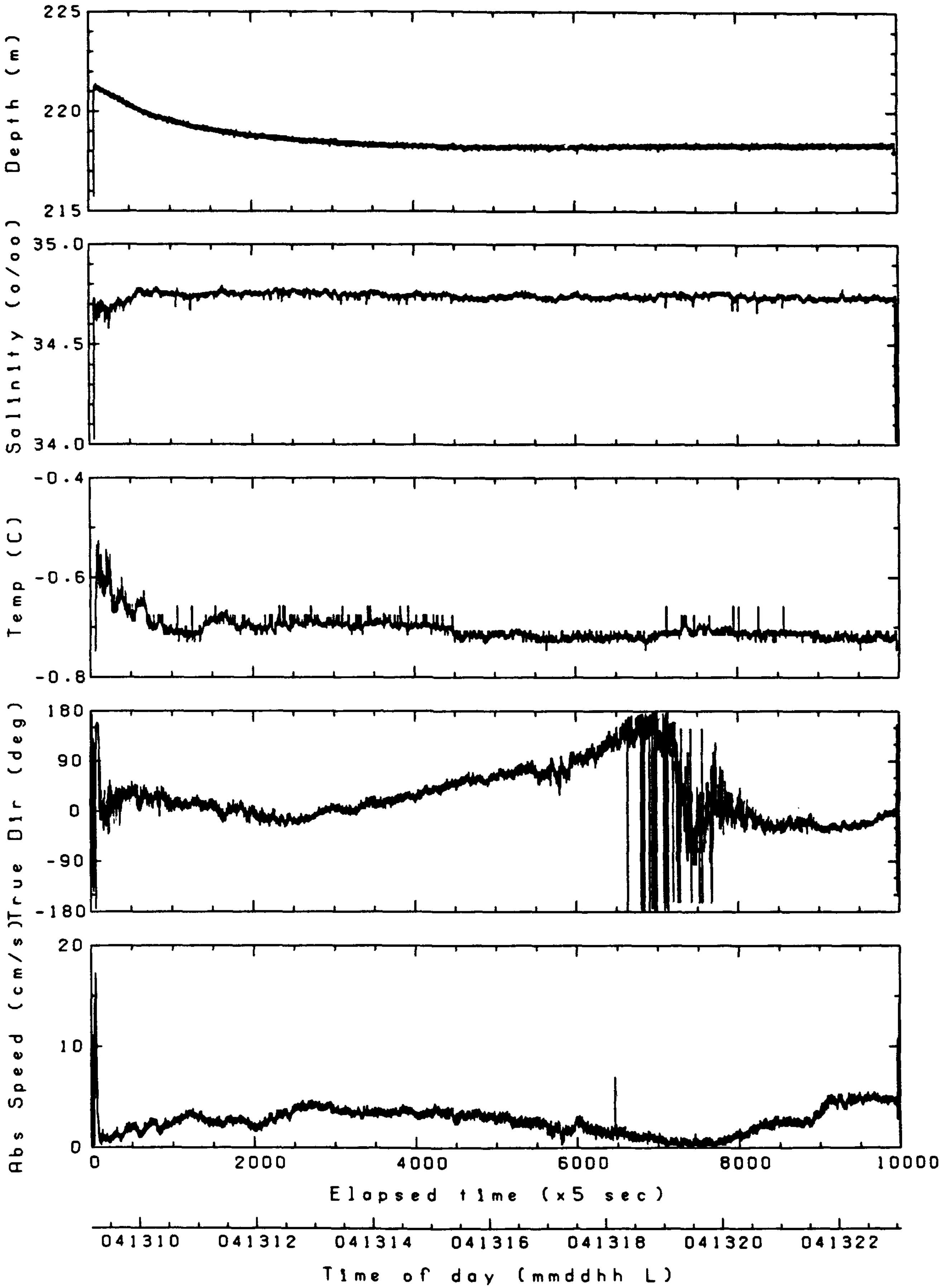


Magnetic bearing + 31 degrees = True bearing
Floe drift speed = 4.9 cm/s
Floe drift direction = 280 degrees True bearing

04/11 1456L Cast 7



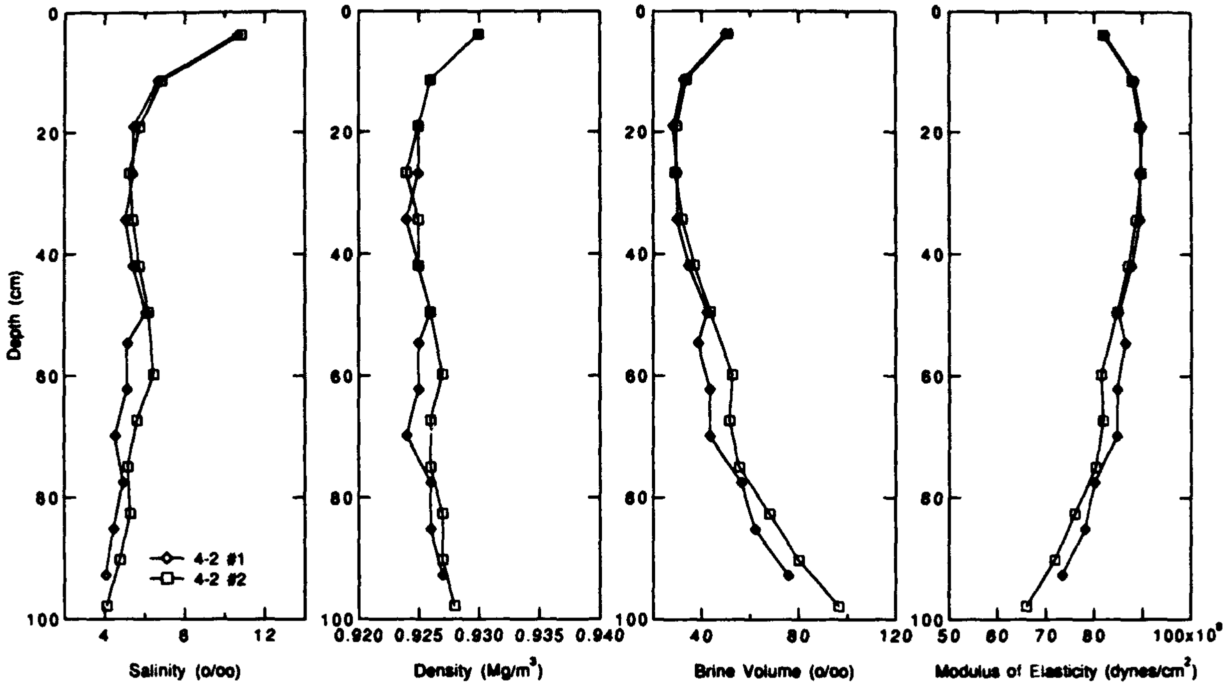
04/13 0915L Cast 8



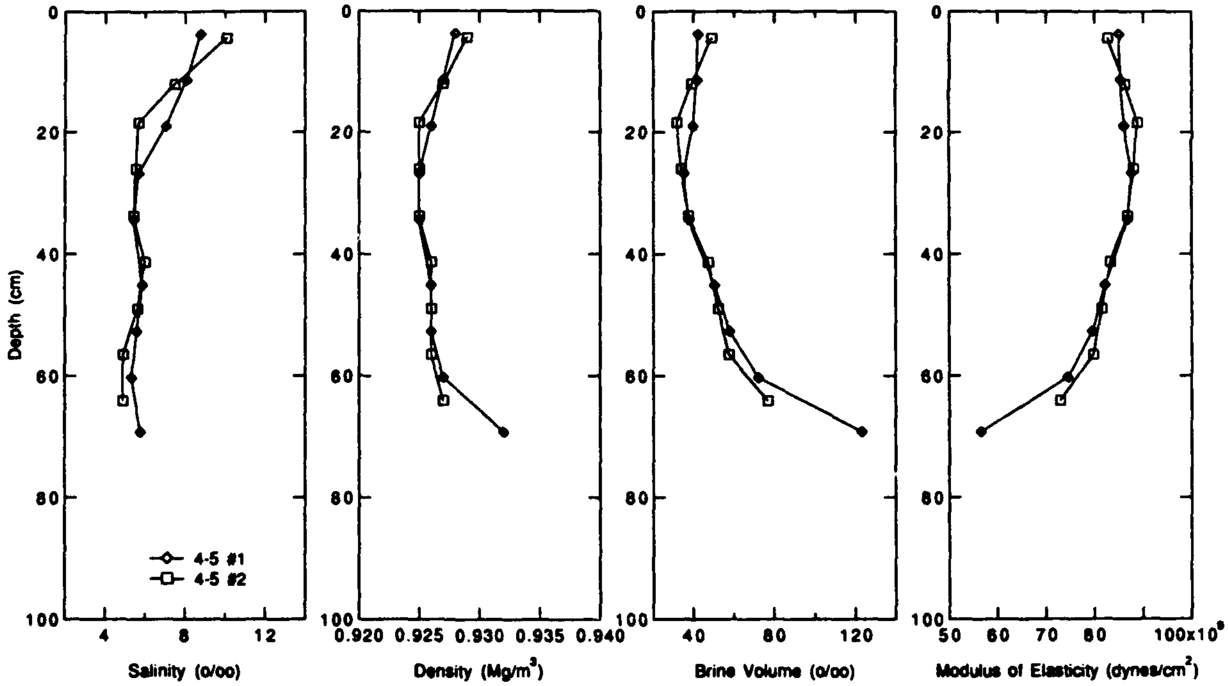
APPENDIX D

Ice Core Data

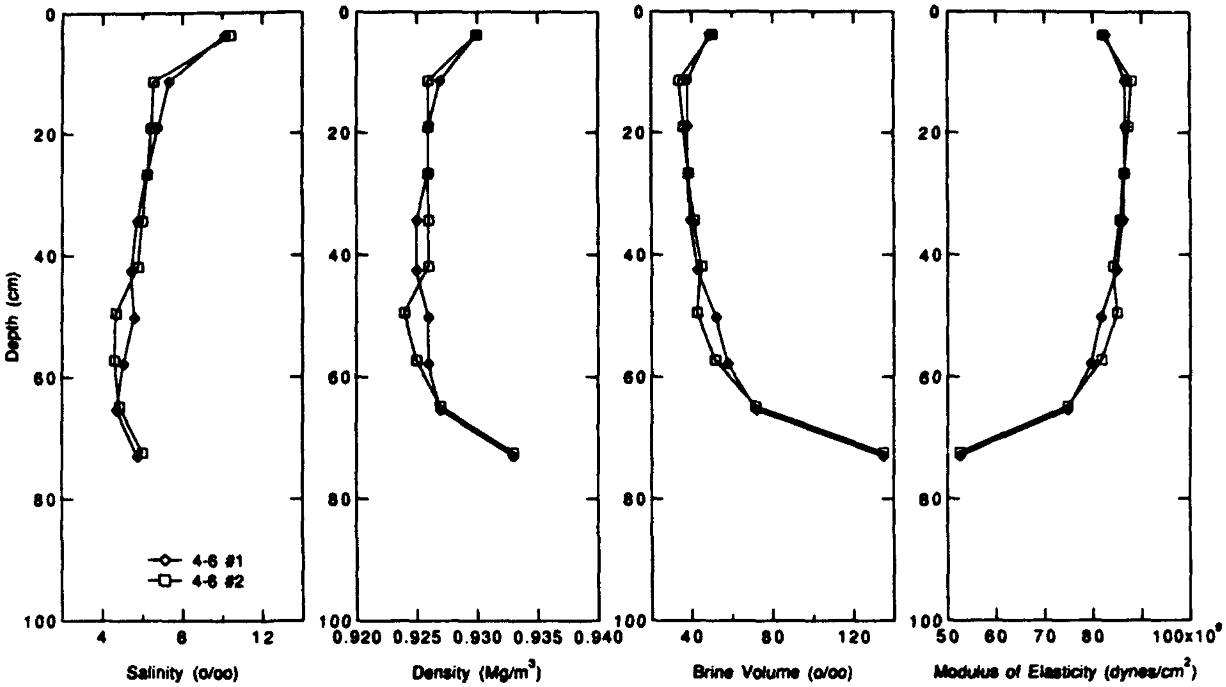
Core No.	Thickness (cm)	Surface Temp. (°C)	Comments
4-2 #1,2	102	−13.0	1.6 m apart
4-5 #1,2	74	−12.7	> 2 m apart
4-6 #1,2	76	−12.7	> 5 m apart
4-11 #1	84	−13.1	
#2,3	85	−13.6	0.5 m apart, >10 m from #1
4-12 #1,2	---	----	Refrozen melt ponds


Depth (cm)
4-2 #1
4-2 #2
Salinity (o/oo)
Density (Mg/m^3)
Brine Volume (o/oo)
Modulus of Elasticity (dynes/cm^2)
100x10^8

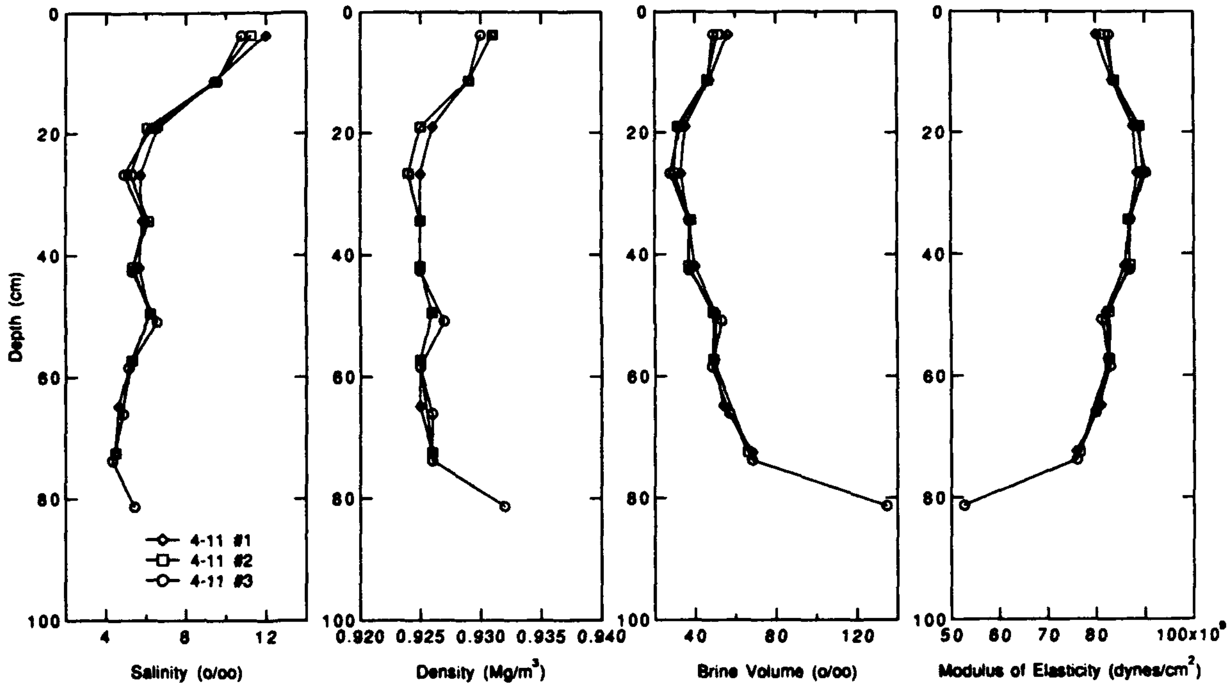
4/2 - #1, #2


Depth (cm)
4-5 #1
4-5 #2
Salinity (o/oo)
Density (Mg/m^3)
Brine Volume (o/oo)
Modulus of Elasticity (dynes/cm^2)
100x10^8

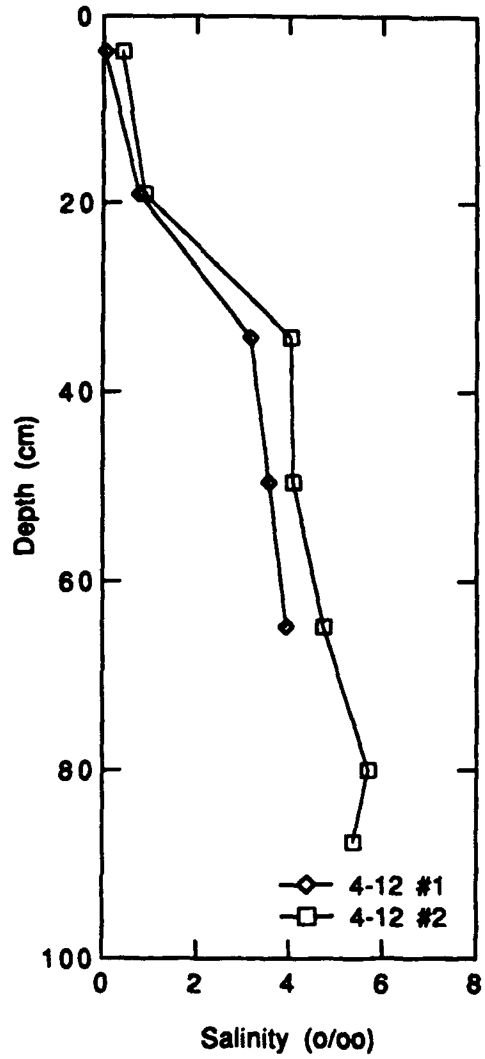
4/5 - #1, #2


Depth (cm)
Salinity (o/oo)
Density (Mg/m³)
Brine Volume (o/oo)
Modulus of Elasticity (dynes/cm²)
4-6 #1
4-6 #2

4/6 - #1, #2


Depth (cm)
Salinity (o/oo)
Density (Mg/m³)
Brine Volume (o/oo)
Modulus of Elasticity (dynes/cm²)
4-11 #1
4-11 #2
4-11 #3

4/11 - #1, #2, #3



0
20
40
60
80
100
Depth (cm)
0
2
4
6
8
Salinity (o/oo)
4-12 #1
4-12 #2

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REPORT DOCUMENTATION PAGE

Form Approved
OPM No. 0704-0188

1. AGENCY USE ONLY (*Leave blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	December 1993	Technical

4. TITLE AND SUBTITLE
Environmental Measurements in the Beaufort Sea, Spring 1993

5. FUNDING NUMBERS
SPAWARSYSCOM
Contract N00039-91-C-0072

6. AUTHOR(S)
T. Wen and F. Karig

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Applied Physics Laboratory
University of Washington
1013 NE 40th Street
Seattle, WA 98105-6698

8. PERFORMING ORGANIZATION REPORT NUMBER
APL-UW TM4-93

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Sponsored by: Naval Sea Systems Command
Monitored by: Arctic Submarine Laboratory
Naval Undersea Warfare Center
San Diego, CA 92152-5019

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

This report presents environmental data obtained by the Applied Physics Laboratory of the University of Washington (APL-UW) at APLIS 93, an ice camp established in the Beaufort Sea in Spring 1993 to support Navy-sponsored tests and research during ICEX 1-93. Data analysis is limited because the purpose of this report is to provide field data to ice camp participants. The data were collected to document the meteorological and oceanographic conditions that existed during camp activities. The main data sets are weather, floe drift, STD profiles, currents, and ice properties.

14. SUBJECT TERMS
Arctic, Beaufort Sea, Currents, Sea ice properties, Floe drift, STD profiles, Weather

15. NUMBER OF PAGES
87

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR